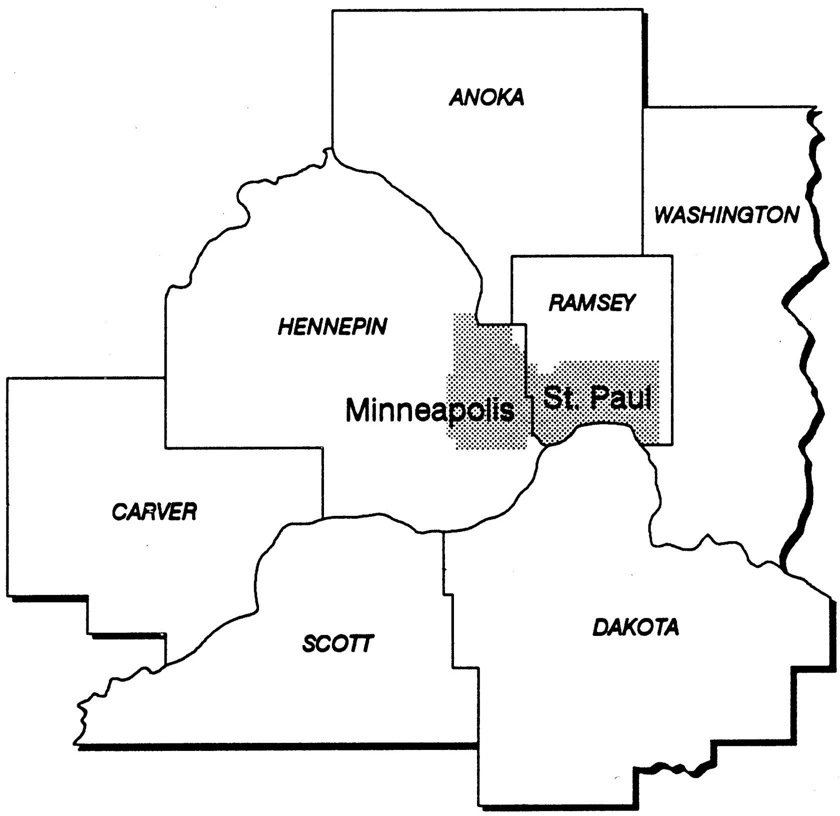
Technical Report

CONGESTION / ROAD PRICING STUDY

Metropolitan Area of Minneapolis and St. Paul



WILBUR SMITH ASSOCIATES
in association with
Strgar - Roscoe - Fausch, Inc.
K.T. Analytics, Inc.

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Metropolitan Area of Minneapolis and St. Paul

Prepared for

Metropolitan Council
Minnesota Department of Transportation
University of Minnesota - Center for Transportation Studies

By

WILBUR SMITH ASSOCIATES
in association with
Strgar - Roscoe - Fausch, Inc.
K.T. Analytics, Inc.

June 1994

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Ladies and Gentlemen:

Wilbur Smith Associates (WSA), in association with Strgar-Roscoe-Fausch (SRF) and K.T. Analytics (KTA), is most pleased to submit this report documenting the results of our preliminary Congestion/Road Pricing Study for the Twin Cities area. The study was conducted on behalf of the Minnesota Department of Transportation, the Metropolitan Council and the Center for Transportation Studies at the University of Minnesota.

The study was intended to provide a preliminary, broad-brush look at the potential viability of congestion and/or road pricing in the Twin Cities area. This included an overview of previous and current experiments in congestion/road pricing worldwide and a summary of emerging technology options in electronic toll collection. Several hypothetical pricing scenarios were identified, with a preliminary pricing and revenue collection structure developed for each. In addition to estimation of traffic and revenue impacts, the study also examined various other measures of effectiveness for each scenario and identified several important issues which will need to be addressed if the concept of congestion/road pricing is to move forward in the Minneapolis/St. Paul metropolitan area.

WILBUR
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Minnesota Department of Transportation
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June 15, 1994
Page Two

This study has clearly been a preliminary assessment and represents just the first step. A more detailed evaluation will be needed before any type of pricing program could be implemented. An important cornerstone of any future congestion road pricing program will be a well-planned, carefully implemented program of public participation. A preliminary outline of a public involvement plan is also included in the study.

Mr. Ferrol Robinson and others on the study team at SRF, and Mr. Kiran Bhatt of KTA join me in gratefully acknowledging the valuable inputs of the Project Management Team and Steering Committee throughout the course of the study. We have sincerely appreciated the opportunity to participate in this study and hope the information included in this report will provide a useful basis for discussion of the concept.

Respectfully submitted,

WILBUR SMITH ASSOCIATES

Edward J. Regan, III
Senior Vice President

EJR/kap

EXECUTIVE SUMMARY

This report summarizes the results of a preliminary feasibility assessment of congestion/road pricing in the metropolitan area of Minneapolis and St. Paul. The study was authorized under a contract with the Metropolitan Council; with funding and administrative guidance provided jointly by representatives of the Council, the Minnesota Department of Transportation and the University of Minnesota's Center for Transportation Studies.

The study addressed the general viability of congestion and/or road pricing concepts. The principal differences between the two concepts lie in the method and scope of application and the primary motivation for implementation.

Congestion pricing, in the classical sense, is aimed explicitly at demand management which might involve relatively high levels of toll charges in more concentrated, congested areas. Road pricing would typically represent a more broadly applied user fee, in which both demand management and revenue generation are key objectives.

Study Objective

The primary objective of the study was to examine a broad range of issues and impacts associated with congestion/road pricing, including estimation of traffic and revenue potential, financial feasibility, social and economic considerations, electronic toll collection technologies and more. The study also included a review of existing and planned congestion/road pricing programs in other locations throughout the U.S. and abroad.

The study was generally considered to be an initial phase in the evaluation and planning for congestion/road pricing. It was a broad-brush analysis, aimed at providing a preliminary indication of viability of the concept and provide sufficient background information to determine if more detailed analyses are warranted. The study did raise a number of issues which should be addressed in future studies. Overall, however, this preliminary analysis has found that congestion/road pricing has the potential to influence the future magnitude and distribution of demand on the Twin City Region's transportation system, while at the same time generating significant revenues for needed transportation improvements and other uses.

Rationale for Congestion/Road Pricing

Overall, transportation systems in most metropolitan areas provide considerable highway capacity. Much of this capacity, however, is required to meet peak-period demands which occur during the limited commuting hours of the week days leaving substantial capacity available in the off-peak. On the other hand, some of the current peak-period capacity goes under utilized for lack of adequate management. Still other potentially available "capacity" is represented by the unused seats in buses and cars. Unfortunately, more than two decades of national experience suggest that travel demand management (TDM) and traffic system management (TSM) applications, as they are generally understood today, can at best be only part of any solution. This is complicated by the pattern of suburbanization in most major urban areas, including the Twin Cities, which has continued to favor solo driving and limited use of public transportation.

The rationale for congestion pricing derives from the relationship between road capacity, people's varying estimates of value on using that capacity, and the level of traffic and congestion. Congestion pricing would be aimed at maximizing the efficiency of use of the total transportation system. This could include: using pricing as a more flexible tool to allocate limited capacity; providing a monetary incentive for ride sharing, shifting to off-peak travel time and/or shifting to transit.

In theory, congestion pricing is intended to assess a charge for each road trip in an amount equal or close to the cost occasioned by the trip. That is, each additional vehicle entering a congested traffic stream causes additional congestion and delay to other users.

Road pricing would also serve as a demand management incentive but would typically be more broadly applied than congestion pricing. Revenue generation would be an important objective of road pricing. At least one potential use of this revenue would be to create further demand management and network efficiency incentives, such as transit subsidies, construction of carpool lots, etc. As such, road pricing might achieve many of the same objectives of congestion pricing but would do so at toll levels which might be considerably lower, albeit more broadly based.

Objectives of Congestion/Road Pricing

The Congestion/Road Pricing Study was coordinated by a Project Management Team, with representatives of each of the sponsor organizations, and a broad-based Steering Committee. At one of the two Steering Committee sessions held in St. Paul, the following objectives of congestion/road pricing were identified and provided an important foundation for the study:

1. Reduce congestion on roadways:

   - Reduce vehicle miles of travel (VMT) during peak periods and/or at congested locations.
   - Convert single occupant vehicle (SOV) use to high occupant vehicle (HOV) use.

2. Increase the economic efficiency of transportation systems:

   - Provide savings to travelers by reducing travel time, fuel consumption and other costs.
   - Reduce social costs related to pollution, infrastructure maintenance, medical care and public safety.

3. Improve air quality:

   - Reduce vehicle emissions.

4. Stabilize transportation financing:

   - Produce revenues to meet needs for transportation facilities and services.
   - Reduce the need for future roadway system expansion.

5. Support regional growth management policies:

   - Encourage development within the Metropolitan Urban Services Area (MUSA).
   - Improve regional access for central city/inner ring residents.

Other Current and Planned Congestion/Road Pricing Applications

The study included identification of previously implemented and planned congestion/road pricing applications throughout the world. The study found that there have been a relatively limited number of actual applications to date, all outside the United States. These include:

- Singapore Area Licensing Scheme;
- Hong Kong Electronic Road Pricing Program;
- Norway-Bergen, Oslo and Trondheim Toll Rings;

- The Swiss Motorway System; and
- The A-1 Motorway System in France.

Of the above, only the Singapore Licensing Scheme is a true congestion pricing program in the classical sense. In that case, a relatively small, concentrated area at the center of Singapore was "priced" in the late 1970s, with access restricted only to vehicles which had prepaid a daily or monthly charge. Initially the program was limited to morning peak periods; it ultimately was extended to the full day.

In Hong Kong, an electronic road pricing system was extensively tested and was about to be implemented. However, following a change in government, and due to concerns about privacy, the program was not implemented. The three Norwegian toll ring projects were designed as revenue generators to fund necessary highway and transit infrastructure programs, with little or no use of congestion or variable pricing strategies. The Swiss motorway system application is limited to trucks, and uses a daily, monthly or annual windshield pass for revenue collection. Its aim is more related to appropriate user cost allocation within this small European country as distinguished from congestion reduction or demand management.

In the United States, two major projects are now in the development stage. The S.R. 91 median lanes toll facility in Orange County, California, is now under construction and is expected to open by 1996. This will use fully electronic, highly variable tolls, which will be directly related to congestion levels in the adjacent toll-free lanes of this congested freeway. Vehicles with three or more occupants will be able to use the median lanes toll free. The San Francisco-Oakland Bay Bridge Demonstration project is the only one of up to five congestion pricing demonstration projects yet to be authorized under the provisions of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.

The solicitation for demonstration projects has recently been extended for a third time and additional proposals are expected in the near future. The ISTEA demonstration program includes provisions for funding of up to five projects, up to three of which may include placing of tolls on Interstate Routes. This is one of the few exceptions to the normal prohibition of tolls on federally funded interstate highways.

Studies of congestion pricing have also been undertaken in the Los Angeles, Seattle, Tacoma and other areas of the United States. Elaborate studies are now underway in London and Cambridge, England, and road pricing systems are soon to be implemented in Stockholm and on the entire British Motorway System.

Electronic Toll Collection

A review was also made of existing toll collection technologies that could be used to implement the various types of congestion/road pricing programs identified for the Minneapolis/St. Paul region. The emergence of electronic toll collection (ETC) has greatly enhanced the potential viability of congestion pricing. Under this plan, motorists participating in the program would be able to equip their vehicles with transponder devices which would allow the "collection" of toll charges directly from prepaid accounts, without the need to construct toll plazas which would add significant costs and congestion. Some technology options will also aid in dealing with potential concerns about motorist privacy and other issues. Some of the options evaluated as part of this study include construction of some conventional toll plazas. Other options rely completely on fully automated, non-stop electronic toll collection.

Typical system concepts were identified for each of the different types of congestion/road programs, along with typical hardware costs for transponders, readers and a central system. While enforcement will always be an important factor in any electronic toll system, it now appears that the technology to facilitate a high level of system integrity and security does exist, and enforcement issues may relate more to legal and regulatory matters than technological limitations.

Hypothetical Concepts Evaluated

Based on the input of the Steering Committee, a series of hypothetical alternative concepts for potential implementation of congestion/road pricing system in the Twin Cities area were identified. These fell into the following four overall categories:

- Spot Locations;
- Specific Facilities/Corridors;
- Areawide Pricing by Road Category; and
- Area Entry Pricing.

In each case, one or more "hypothetical" facilities or corridors were chosen randomly for analysis. This was only for illustrative purposes, and the facilities selected do not represent actual pricing proposals or recommendations.

Spot Locations - For the purposes of this analysis, existing and/or planned bridges in the Twin Cities area were found to be ideal examples of spot pricing. Four individual bridges were analyzed, including two existing bridges, the I-494 Wakota Bridge and the Wabasha Street Bridge, and two new bridges, the Anoka bridge and the Stillwater Bridge. Additionally, a hypothetical screenline covering five bridges along the Minnesota River between Trunk Highway 41 and Trunk Highway 77 was evaluated.

For the purposes of this study, it was assumed that tolls would not be charged to vehicles with two or more occupants. Tolls would be assessed to commercial vehicles, regardless of occupancy. Three levels of tolls were studied, including a $0.50 toll in each direction, a $1.00 toll in each direction, and a $1.00 one-way toll. Offpeak tolls were assumed to be discounted by half.

The analysis projected annualized costs ranging from $600,000 for tolling a single bridge to almost $9.0 million to toll the five-bridge screenline. Projected annual revenues for 2015 traffic conditions range from $2.7 million to $53.0 million for a single bridge and five bridges, respectively. In all cases, annual toll revenue was estimated to be considerably higher than operating costs.

The analysis also showed that of the five alternative locations studied, traffic diversion from the toll bridges under the single facility scenario would be constrained by the available capacity of the adjacent toll-free bridges. Diversions from the five-bridge screenline over the Minnesota River would be limited due to the large area served by the five bridges. Diversions to transit and carpools would be more attractive for the five-bridge screenline scenario, where few alternative toll-free river crossings are available, and where an HOV lane and LRT line is planned in the future (on I-35W).

Specific Facility/Corridor - For the purposes of this study, two limited-access facilities within the Twin Cities region were analyzed separately as toll facilities operating with peak period pricing. The existing I-94 from Rogers to downtwon Minneapolis was chosen to represent a hypothetical existing corridor for the purposes of revenue and cost calculations, and the proposed Trunk Highway 212 from I-494 in Eden Prairie to Carver County was chosen to represent a hypothetical new facility. In both of these single facility concepts, it would be possible to use electronic toll collection. However, the study has found that the less broad the pricing application, the more likely it is that at least partial traditional toll collection techniques may also be required.

On the proposed Trunk Highway 212 project, annual revenue at 2015 levels was estimated at between $6.0 and $10.5 million, depending on toll levels. Considerably more revenue potential exists in the existing I-94 corridor, with estimated annual toll revenues of $26 to $44 milllion, depending on the toll rate level assumed. The corresponding estimated capital and operation cost, at 1994 levels, for implementation of a toll collection system on TH 212 would be $2.6 million, and on I-94, $10.9 million.

Areawide Pricing by Road Category - Two types of areawide pricing were identified for this study: tolls on the full limited access roadway system, and tolls in

HOV/LRT corridors. Tolls in HOV/LRT corridors would involve tolls on the single-occupant vehicles traveling on the freeways immediately adjacent to existing or planned HOV lanes or LRT lines or possibly tolls on non-HOV traffic using HOV lanes. In all cases, revenue collection would be based on distance traveled and time of day, and would be fully electronic.

Tolls on the limited access roadway system would involve application of congestion/road pricing on all freeways within the seven-county region. Under this innovative regional road pricing concept, all toll collection would be performed electronically. For the purposes of this study, it was assumed that all vehicles registered within the seven county region would be equipped with transponders capable of being read at the various monitoring locations throughout the region. A series of border stations would be established at the perimeter of the seven-county region to make temporary transponders available to non-local traffic.

The full freeway pricing system would have the greatest potential for encouraging carpooling and transit utilization. By pricing virtually all limited access facilities, the overall level of toll charges would be greater and the number of alternative routes would be reduced. As a result, transit or carpooling would be relatively more attractive. Annual revenue at the lower of two toll rates tested was estimated at between $302 and $348 million, depending on the area and road classes covered by the tolls. At the higher of the toll rates, annual revenues of $458 and $535 million were projected.

The cost of establishing and operating a regionwide freeway pricing system would be substantial. This would include construction of border toll stations around the seven-county metropolitan area and installation of electronic toll collection readers and other devices at virtually all interchanges on the freeway system. The cost to equip all vehicles in the Twin Cities region with electronic toll transponders is estimated at about $60 million, bringing the total capital cost of implementation to about $200 million, or more. Assuming a ten-year life cycle for the capital investments, the total annualized cost for the full freeway road pricing system would be between $60 and $70 million, at 1994 levels, depending on the scope of application.

Table ES-1 provides a summary of estimated traffic impacts along four selected screenlines in the Twin Cities area. Two north-south screenlines and two east-west screenlines are shown. Under this scenario, road pricing is assumed to be implemented under two alternative toll rates on all freeways within the affected area. As might be expected, implementation of this pricing would result in a reduction of traffic on the freeways due to diversion to alternative routes and a net reduction of auto trips due to shifts to carpools and transit.

Table ES-1
SUMMARY OF ESTIMATED TRAFFIC IMPACTS
Regionwide Freeway Road Pricing Options
2015 Levels

TRAFFIC SCREENLINE	ROUTES	BASE CASE TRAFFIC	TOLL RATE 1 (1) Traffic	TOLL RATE 1 (1) Net Impact	TOLL RATE 1 (1) Percent Impact	TOLL RATE 2 (2) Traffic	TOLL RATE 2 (2) Net Impact	TOLL RATE 2 (2) Percent Impact
	(------Traffic in Thousands of Vehicles Per Day------)							
West of TH 100 (North-South)	Freeways	572	526	(46)	(8.0)	462	(110)	(19.2)
	Other	395	420	25	6.3	471	76	19.2
	Total	967	946	(21)	(2.2)	933	(34)	(3.5)
Between I-35W and I-35E (North-South)	Freeways	510	474	(36)	(7.0)	413	(97)	(19.0)
	Other	318	337	19	6.0	388	70	22.0
	Total	828	811	(17)	(2.1)	801	(27)	(3.3)
South of I-94/694	Freeways	551	499	(52)	(9.4)	425	(126)	(22.9)
	Other	350	381	31	8.9	439	89	25.4
	Total	901	880	21	(2.3)	864	(37)	(4.1)
South of I-394/94	Freeways	689	652	(37)	(5.4)	600	(89)	(12.9)
	Other	316	333	17	5.4	370	54	17.1
	Total	1,005	985	(20)	(2.0)	970	(35)	(3.5)

NOTE: Traffic impacts include both diversions to alternate routes and approximations of trip reduction due to shifts to carpools and transit.
(1) Peak period toll of $0.05 per mile, off-peak toll of $0.03 per mile.
(2) Peak period toll of $0.10 per mile, off-peak toll of $0.05 per mile.

For example, at 2015 levels, an estimated 572,000 vehicles per day would cross a north-south screenline located west of TH 100 on the various freeway routes. An additional 395,000 vehicles cross the screenline on arterials and other local streets, yielding a total of just under 1 million vehicle crossings per day. At the lower toll rate ($0.05 per mile in peak periods) freeway traffic would be reduced by about 8 percent, with slightly more than half of this impact resulting from diversions to other routes. A more significant impact is shown at the higher toll rate ($0.10 per mile), with a reduction in freeway volumes of over 19 percent. The majority of this would result from diversions to alternative routes, with the net overall reduction in screenline traffic estimated at 3.5 percent.

Similar results are shown for each of the four selected screenlines, with the low toll rates resulting in freeway traffic reductions of between 5.4 and 9.4 percent and the high toll rates resulting in freeway trip reductions ranging from 12.9 to 22.9 percent, depending on locations. Overall regional traffic would be expected to be reduced between 1.9 and 4.1 percent depending on screenline and toll rate.

This overall category also included a preliminary evaluation of congestion pricing in selected HOV and/or LRT corridors. In this case, tolls would be assessed only in those segments of the regional freeway system which included carpool lanes. Two "sub-options" were considered. In the first case, tolls would be assessed to all traffic using the non-HOV lanes, to provide a monetary incentive for carpooling or LRT usage. This was analyzed both on a full time tolling basis and as a scenario in which tolls would be applied only during peak periods in the major travel direction only.

The second sub-option would allow non-HOV traffic to use designated HOV lanes for a toll. This concept, often referred to as HOV "Buy-In", has gained increasing interest in recent months following the successful financing of the S.R. 91 Median Lanes project in California. Several HOV Buy-In proposals were submitted under the ISTEA Congestion Pricing Demonstration project. While in the initial solicitations FHWA determined that these proposals were not compliant with the provisions of the Congestion Pricing Demonstration Program, they have since modified their stand and have indicated the HOV Buy-In concept may be considered in certain cases. Given the current nature of HOV lanes on the Twin Cities freeway system there would be enforcement difficulties associated with the HOV Buy-In concept, which need considerably further review in future studies. As such, traffic and revenue estimates were not developed in this study for the HOV Buy-In concept.

MUSA Area Pricing - The final set of road pricing options involved the hypothetical establishment of entry tolls around the Metropolitan Urban Services Area (MUSA) boundary. Under this concept, MUSA border tolling stations would be established on all routes, including freeways and non-limited access. Vehicles registered inside the MUSA area would be exempt from tolling; all other vehicles crossing the MUSA line would be charged entry tolls. Three levels of hypothetical toll charges were tested, ranging from $0.50 to $1.50, and it was assumed that annual passes at discount rates would also be available.

Traffic impacts associated with the entry toll concept would be expected to be relative minimal since all routes entering the area would be tolled. Revenue potential was found to be relatively low, ranging from $15.7 million to $30.3 million depnding on toll rate. The cost of implementing and operating the various toll plazas was estimated at over $18.8 million per year, providing a very low ratio of revenue to cost.

This particular strategy was aimed at encouraging future development within the MUSA boundary, rather than for demand management or for its revenue potential.

Revenue/Cost Summary - Table ES-2 provides a comparative summary of estimated annual costs of implementing and operating toll collection facilities and estimated annual revenue, at 2015 levels. A minimum revenue/cost ratio of 1.0 would be needed to cover the cost of implementing and operating the toll facility. The higher the ratio, the more net revenue which would be produced by the pricing initiative which could ultimately be used for a variety of purposes.

The maximum revenue/cost ratios were found under the full freeway road pricing system concepts. The overall lowest were found under the MUSA Line Entry Toll Options. The HOV/LRT corridor pricing option, in which tolls would be assessed in peak periods only, also show a low revenue/cost ratio, due to the large capital and operating costs as compared with the limited scope and duration or price application.

Other Considerations

Beyond the traffic, revenue and cost implications discussed above, there are a number of important additional factors that must be taken into consideration when evaluating the viability of implementing congestion/road pricing.

Public/Political Acceptability - Congestion/road pricing options will be perceived as more or less acceptable depending on the nature and extent of the pricing scheme. Past experience suggests that several important issues can "make or break" pricing proposals. These issues are: perception of fairness, proposed use of funds, possible impacts on businesses and low income groups, and privacy concerns. Acceptability will be enhanced by consulting with affected parties at the outset of planning, as well as developing liaison with likely supporters. A revenue-neutral program may enhance acceptability as

Table ES-2
REVENUE/COST SUMMARY

SCENARIO	TOTAL ANNUAL COST (000)	LOW TOLL RATES Annual Revenue (000)	LOW TOLL RATES Rev/Cost Ratio	HIGH TOLL RATES Annual Revenue (000)	HIGH TOLL RATES Rev/Cost Ratio
Spot Locations (1)					
New Anoka Bridge	$600	$3,200	5.33	$4,000	6.67
New Stillwater Bridge	600	2,700	4.50	3,300	5.50
Wabasha St. Bridge	700	2,500	3.57	2,700	3.86
I-494/Wakota Bridge	3,000	12,500	4.17	16,300	5.43
Minn. River Bridge Screenline	8,950	41,700	4.66	51,600	5.77
Full Freeway System					
MUSA Area Only	59,540	301,700	5.07	457,500	7.68
Full 7-County Area	60,950	318,900	5.23	482,000	7.91
Full Area with Expressways	71,000	347,500	4.89	534,700	7.53
Single Corridor Options					
I-94	10,850	25,900	2.39	44,000	4.06
TH 212	2,550	6,000	2.35	10,500	4.12
HOV/LRT Corridors (Tolling SOV Lanes)					
Peak Period/Major Dir. Only	41,890	--	--	26,000	0.62
Full Time Tolling	45,890	--	--	185,000	4.03
MUSA Line Entry Tolls (2)	18,650	15,700	0.84	30,300	1.62

(1) All bridge scenarios assume 2-way toll collection.
(2) Includes a reduction of 50 percent in the cash-paying component at unattended entry locations, and 10 percent at attended locations to account for toll evasion.

compared with a program where pricing is perceived simply as a way to raise revenues.

Because active support of congestion/road pricing plans is vital to political acceptability and approval of proposals, it is important to identify and involve possible supporters early in the planning process. For those who may be opposed, areas of possible opposition should be identified at the outset. Possible supporters include those who benefit from reduced congestion including: neighborhoods where traffic might be reduced; commercial enterprises highly dependent on goods delivery and traveling sales force; environmental interests concerned with air quality; transit operators receiving support for expanded capital stock and experiencing better speeds under less congestion; and automobile organizations interested in expanded road facilities, provided congestion/road pricing is part of a broader plan to add highway capacity at critical locations.

Potential Uses of Revenue - Congestion/road pricing programs are likely to generate a substantial revenue stream. The uses of these revenues can influence both public support for the program and the effectiveness of the program itself. Decisions on uses of revenues should be based upon principles that reinforce the overall objectives of congestion/road pricing. They must also reflect a variety of public policy considerations related to transportation needs, equity concerns, and jurisdictional priorities.

Implementation Costs - Revenues should first be applied to the annualized operating and capital costs associated with the collection of tolls and fees, including the costs of enforcement, public outreach, and administration.

Provision of Travel Alternatives - Use revenues to provide reasonable transportation alternatives to peak period SOV travel. Transit services and facilities, HOV lanes, and improving alternate routes should be supported by program revenues. Providing attractive options, particularly if they offer faster travel and/or less expensive travel, will help foster support for congestion/road pricing.

Mitigation of Negative Impacts - Revenues could be used as direct subsidies in the form of travel allowances to reduce cost impacts to low-income travelers. Such compensation would need to be designed so as to maintain the incentive for changing travel behavior. This use of revenues would address some equity concerns.

Implementation of the Regional Transportation Plan - Revenues could be directed to further improvements identified in the regional transportation plan and would include transit and highway improvements, in support of the dampened travel demand resulting from congestion/road pricing. Highway improvements to mitigate the impact of traffic diversion from the tolled routes to local non-tolled routes may also be required.

Reduced Taxes - Revenues could be returned to travelers in the form of reduced taxes. Toll revenues could substitute for a portion of revenues from current property, gasoline and excise taxes used for transportation improvements. Opposition to congestion/road pricing (because it might be viewed as a new tax and revenue source for government), could be reduced by structuring a "revenue-neutral" program.

Other Uses - Revenues could be applied to non-transportation public uses. However, this would weaken the "pay-as-you-go" approach to transportation financing and would establish congestion/road pricing as another tax.

Consistency with Regional Goals - Congestion/road pricing can be structured to support the following regional transportation goals.

Contribution to Region's Quality of Life - Among the congestion/road pricing applications examined, the areawide and systemwide options have, by far, the greatest potential for reducing congestion by improving travel time and improving the environment in the region - thus contributing to the region's quality of life. Spot or facility applications of congestion/road pricing such as on individual bridges or freeways will have very localized beneficial impact on quality of life. In fact, because of the negative impacts due to spillover of traffic onto parallel routes, the net benefit is likely to be small, if any. The one exception might be the "HOV Buy-In" concept which would not be expected to divert traffic to alternative routes.

Impacts on Business - The impacts of congestion/road pricing on business will vary with the structure of the pricing program, the nature of the businesses, level of competition, and other factors. Reductions in traffic congestion will create benefits by reducing the travel time (and, therefore, costs) of goods delivery. These savings should offset the direct increases in shipping expenses created by the pricing program. Concerns about impacts on retail businesses relate to shoppers potentially facing high travel costs, particularly if only some retail destinations are affected by the pricing program.

According to several federal studies, truck operators value their time at $25 to $30 per hour (this will vary for local delivery versus long-haul, etc.). If a relatively low truck toll rate of $0.10 per mile is assumed for a 20-mile round-trip, only about five minutes of overall travel time savings from reduced congestion would need to be realized in order for the trucker to gain from the program.

Management of Existing Transportation System - One of the primary objectives of any type of road pricing system is to manage the transportation system to satisfy travel demand while making the most effective use of limited resources. All of the options evaluated would provide some measure of demand management. The spot application of pricing would act to redistribute traffic between facilities, and, to a lesser extent, encourage ridesharing or demand reduction. The concept of pricing mixed-flow lanes on segments adjacent to HOV lanes would provide a more direct incentive to ridesharing and thereby achieve a more balanced utilization of total available capacity while acting to reduce vehicular miles of travel.

In general, the broader the application of pricing in the region, the greater the ability to manage demand and thus achieve regional goals and policies. The placement of congestion/road pricing on the entire limited-access freeway network would have the greatest potential to achieve demand management objectives by both reducing and redistributing demand more efficiently over the existing network. The use of electronic pricing would make it possible to adjust rates by time of day and roadway section to achieve the optimum balance and overall management of the system. If a portion of revenues generated from the pricing system were used to create travel alternatives, such as enhanced transit or ridesharing opportunities, the overall system management capabilities would be further increased.

Strengthening of Transit - Congestion/road pricing would provide a direct, highly visible, monetary incentive for increased use of transit and/or ridesharing. The extra "price" placed on driving alone would, at a minimum, reduce the perceived relative cost of transit fares, thereby increasing the transit share especially for work trips. Congestion/road pricing applications would also provide opportunities for generating revenue. Part of these revenues can be used to strengthen the transit system (regular route, paratransit and rideshare). The better the transit system that is in place, the greater the success of congestion/road pricing. The improved transit system will provide increased choices for SOV users that are unwilling to pay the road pricing fee, which in turn will make the transit system more cost-effective.

Availability of Stable Funding for Transportation - Because of the dollars involved, areawide or systemwide congestion/road pricing provides a "pay-as-you-go" revenue-generating method that is relatively stable. Unlike gas tax revenues, which have experienced a decline due to improved vehicle fuel efficiency, revenues from congestion/road pricing would increase because of the historical growth in vehicle-miles of travel. It would also be a good method of dealing with future transition to electric vehicles and other alternative fuel sources.

Support Economic Development - The effect of congestion/road pricing on economic development is not well understood. However, the following observations can be made and should be evaluated in subsequent phases of the study of congestion/road pricing:

- Central business districts (CBDs) could benefit from congestion/road pricing because they have the best roadway and transit access and, thus, the most choices. This is true of commuter trips. However, shoppers might be unwilling to pay the additional fee to shop in the CBD.

- While the great majority of the region's population and employment is within the Metropolitan Urban Services Area (MUSA) boundary, residential and other development continues to occur outside the MUSA. One of the main reasons for this occurrence is that there are no incentives to live closer inasmuch as the transportation system currently provides relatively congestion-free travel. Distance-based congestion/road pricing would make it less attractive to live in the rural or developing areas and work, say, in the CBDs.

- Residents of counties adjacent to the seven-county area could be discouraged from working or shopping in the region, particularly if areawide or systemwide congestion/road pricing applications are implemented.

- An unknown at this time is whether, under the areawide or systemwide options, new businesses will make a different location decision, or whether existing businesses would relocate, to avoid the tolls.

It is likely that specific geographic areas within the seven-county region could experience an economic gain at the expense of other geographic areas but, overall, the economic impact is likely to be neutral. The exception is the case where a business would locate or relocate outside the seven-county area. Imposition of an entry fee at the MUSA boundary might encourage some residents or businesses to move into the MUSA area. Others, however, might decide to move into the rural areas and outer rings to avoid the tolls. How these decisions are made will depend, to a large extent, on how adverse impacts to commuters, residents and businesses, and geographic impacts, are mitigated. Mitigation measures could include commuter rebates, peak-period-only charges, improved services to affected business centers, various tax rebates, etc. It is quite clear that impacts on development patterns and economic growth must be given considerable analysis in future studies, regardless of the particular congestion/road pricing option selected.

Impacts on Low Income Travelers

The impact of congestion/road pricing on low-income travelers depends upon the adopted price level, the time savings achieved, and employment locations, among other factors.

The lower the value that is placed on one's time, the less there is to gain, in an economic sense, from congestion/road pricing. According to federal studies, travelers making work trips value their time at $11.00 per hour; on average, those making non-work trips value their time at $8.00 per hour. If, for a typical 20-mile round-trip, a relatively low toll rate of $0.05 per mile is imposed and five minutes of travel time is saved, then only workers whose annual incomes exceed $25,000 would stand to gain based on their value of time. For non-workers, their income would need to be 25 to 50 percent higher.

The impacts on low-income travelers will depend on the availability of travel alternatives and residential and employment characteristics. Low income residents are more likely to live in areas where transit services are available (transit would tend to improve under congestion/road pricing). Some would be induced to change from auto travel to bus. However, many low-income travelers must use a car because transit is not available, for child pick-up, etc; if employed, they may have little flexibility to alter work hours and thus would face peak period charges. These changes could be significant to the individual traveler especially if travel distances are long.

A carefully structured congestion/road pricing program that maximizes alternatives and provides some form of subsidy would help mitigate these potential negative effects on low income travelers. A portion of the revenue collected from the pricing program could be used to reduce the negative impact on the poor.

Land Development Considerations

The implementation of congestion/road pricing might be expected to have some limited impacts on future land development patterns, depending on the scenario and the scope of application. For example, an area entry pricing scheme focused around a CBD, such as in Singapore, might act to encourage utilization of businesses outside the protected area and therefore might influence future commercial development patterns. That particular scenario was not, however, among those selected by the Steering Committee for further review. The MUSA line entry toll program was explicitly designed as an incentive to continued future development within the MUSA area. This is consistent with regional transportation planning goals, which state that future highway and transit services will be focused in the urban development area. This would be a direct positive impact of implementing pricing on regional development patterns.

As noted previously, it is difficult to identify some of the more subtle economic development impacts. For example, if all freeways in the region were subjected to tolls, it would not be expected to result in a significant change in future development patterns. However, if only one or a few of the freeways were tolled, this could affect development choice locations for both residential and commercial development. Potential impacts on economic development patterns should be the subject of more detailed analysis in refined studies.

Air Quality Considerations

Congestion/road pricing may reduce vehicle emissions by reducing vehicle trips. Trip curtailment and shift from solo driving to HOV modes would result in reduced vehicle trips and VMT and produce reductions in emissions. Changes in travel routes and in trip times is likely to have more complex differential impacts on emissions and air quality. These changes may not directly reduce VMT, but by shifting VMT away from hot spots and hot periods, they could produce improvements at the worst locations and times. In making the estimate of VMT reduction, evaluation analysts should be careful to assess net reductions in VMT. This can be done by examining changes in trip volumes and lengths not just on the priced facility, but on possible diversion routes, and comparing results to changes in the same variables on control facilities not priced. Obviously, improvements in running speed and the reductions in start-stop cycles from reduced congestion should also be recognized in future studies.

Equity Considerations

An important consideration in assessing congestion/road pricing options in the region is equity: how costs and benefits of the options affect particular groups. Such considerations will help chart the most politically feasible course, help determine those made worse off, and where compensation should be focused. Some categories to consider include income group, peak versus off-peak travelers, and in- versus out-of-zone workers, businesses and residents.

In general, one would expect positive benefits due to reduced congestion to accrue to the following individuals or groups:

- *Existing users of HOV modes and HOV service providers* - A reduction in congestion could significantly increase HOV mode speeds, productivity and reliability. Existing HOV traffic in the mixed flow lanes would enjoy improved service due to congestion reduction without being required to pay tolls. The bus operating agency could benefit from increases in vehicle productivity as speeds increase.

- *Road users who shift from SOV mode to HOV due to pricing incentives* - Those who voluntarily are attracted to HOV modes due to enhanced service levels would realize positive benefits from the opportunity to use a more desirable mode.

- *Road users who continue to drive and value their time highly (including most commercial vehicles)* - The value of time savings reduced by lower congestion and increased speeds would outweigh the increased congestion toll payments for these users.

- *Businesses who would reap the benefits of more efficient delivery systems* - Businesses where trucking and delivery system costs are a significant proportion of total costs of doing business would realize large savings in delivery costs.

- *Population segments who will enjoy cleaner air* - Persons living/working near high concentrations of pollutants produced by vehicle emissions would enjoy cleaner air.

- *Major recipients of the revenues generated by the pricing program* - Congestion/ road pricing will generate new revenues, far in excess of program costs. If revenues are used to expand HOV modes, the original and new users of these modes would enjoy the benefits. If revenues are used to reduce existing taxes such as registration fees, the affected motorists would gain. If revenues are used to compensate particular road users or businesses, they would benefit. Depending on the compensations, such distributions could partly or fully mitigate negative impacts of pricing on these groups.

Disbenefits due to congestion/road pricing could be experienced by the following individuals or groups:

- *Those who do not value their time highly and/or cannot afford the increased charges* - Those who are forced to pay more than their time savings, or who involuntarily have to shift to other modes of travel, routes or time or travel, would lose benefits, as well as those who must decide to forgo the trip altogether. Low-income travelers are susceptible to the above effects.

- *Certain businesses in the region who might lose competitive posture compared to those in outlying uncongested areas* - While many businesses may benefit from improved speeds for goods delivery and employee commutes, some businesses within the priced zone may experience greater competition from businesses outside the priced zone. Again, how complementary programs and actions are structured can change this picture.

- *Users of unpriced facilities in the region* - Travelers on certain facilities not priced may experience increased costs of congestion if much traffic is diverted from priced facilities.

- *Neighborhoods* - Certain neighborhoods may be affected by spillover traffic. This is particularly true of neighborhoods where good alternative parallel arterials or transit facilities are unavailable.

Comparative Impact Summary - The various hypothetical congestion/road pricing scenarios evaluated in this preliminary study covered a wide range of applications. As such, they would also vary considerably with respect to evaluation criteria established by the Steering Committee at the outset of the study.

A comparative summary of the relative impact of each of the options under each of the evaluation factors is presented in Figure ES-1. Given the preliminary nature of this study, a simplified relative rating scale was considered appropriate, with impacts generally ranging from unfavorable to favorable.

It was not the intention of this study to select on optimum implementation strategy and no recommendations are made. The results of the study do provide considerable data regarding a range of options which can be considered by decision-makers in planning possible future initiatives.

The Next Steps

Considerably more detailed study would be needed before an actual pricing strategy could be selected and implemented. This preliminary study identified a number of issues which should be looked at in more detail in the future. The study team suggested a three-phase level of future analysis, including:

- A Scoping Study;
- A Detailed Alternatives and Impact Analysis; and
- Preliminary Design and Implementation Plan.

A key element of all future work with respect to planning congestion/road pricing initiatives will be a well-planned, carefully implemented program of public involvement. This study included the development of a preliminary public involvement plan, which will, no doubt, be a major focal point of any future studies of congestion/road pricing in the Twin Cities area.

EVALUATION CRITERIA	SPOT LOCATIONS		HOV / LRT		SINGLE CORRIDOR OPTIONS	FULL FREEWAY PRICING	MUSA AREA PRICING
	Ind. Bridges	Screen-line	Toll Non-HOV	HOV Buy-In			
CONGESTION RELIEF							
• SOV Reduction	○	◐	●	○	◐	●	○
• Congestion Reduction	◐	◐	◐	◐	◐	●	○
• Travel Time Reduction	○	◐	●	◐	◐	◐	○
MODE SHIFT POTENTIAL							
• Increase Transit	○	◐	●	○	◐	◐	○
• Increase Ridesharing	◐	◐	●	○	◐	●	◐
REVENUE/COST CONSIDERATIONS							
• Revenue Potential	◐	◐	◐	○	◐	●	◐
• Revenue/Cost Ratio	◐	●	◐	◐	◐	●	○
OPERATIONAL EFFECTIVENESS							
• Ease of Use	◐	◐	◐	○	◐	◐	○
• Ease of Enforcement	●	●	◐	○	●	◐	○
PUBLIC/POLITICAL ACCEPTABILITY							
• Equity/Availability of Options	●	◐	◐	●	◐	●	○
• Low Income Impacts	◐	◐	◐	◐	◐	○	◐
• Business Impacts	◐	◐	◐	◐	◐	◐	◐
• Local Traffic Diversions	◐	◐	◐	●	○	○	◐
AIR QUALITY IMPACTS							
• VMT Reductions	○	◐	◐	○	◐	●	○
• Improve Average Speeds	○	◐	◐	◐	◐	◐	○
REGIONAL DEVELOPMENT GOALS	○	◐	◐	○	◐	◐	●

○ Unfavorable Impacts
◐ Moderate/Neutral Impacts
● Favorable Impacts

OVERVIEW OF RELATIVE IMPACTS

CONTENTS

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CONTENTS (Cont'd)

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CONTENTS (Cont'd)

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CONTENTS (Cont'd)

ILLUSTRATIONS

TABULATIONS

Chapter 1
INTRODUCTION

This report documents the results of a preliminary feasibility study of congestion/road pricing in the metropolitan area of Minneapolis and St. Paul. The study was authorized through a contract with the Metropolitan Council; with funding and administrative guidance provided jointly by representatives of the Council, the Minnesota Department of Transportation and the University of Minnesota's Center for Transportation Studies.

As denoted in its title, the study addressed congestion and/or road pricing concepts. The two concepts are, indeed, quite similar and, to varying degrees, would each achieve the same outcomes. As described in more detail below, the principal differences between the two concepts lie in the method and scope of application and the primary motivation for implementation. Congestion pricing, in the classical sense, is aimed explicitly at demand management that would typically involve relatively high levels of toll charges in more concentrated, congested areas. Road pricing would typically represent a more broadly applied user fee system in which both demand management and revenue generation are key objectives.

The primary objective of the study was to examine a broad range of issues and impacts associated with congestion/road pricing, including estimation of traffic and revenue potential, and financial feasibility, identification of social and economic considerations and review, electronic toll collection technologies and more. The study also included a review of existing and planned congestion/road pricing programs in other locations throughout the U.S. and abroad.

The study is considered to be an initial phase in the evaluation and planning for congestion/road pricing. It is a broad-brush analysis, aimed at providing a broad indication of viability of the concept and sufficient background information to determine if more detailed analyses are warranted. It is not anticipated that the results of this study would be used to necessarily reach final decisions regarding implementation of congestion/road pricing.

Considerably more detailed studies should be undertaken before any type of regional road pricing system is implemented. This study did raise a number of issues which should be addressed in future studies. Overall, however, this preliminary analysis has found that congestion/road pricing has the potential to influence the magnitude and distribution of future demand on the region's transportation system, while at the same time generating significant revenues for needed transportation improvements or other uses.

Scope of Study

Consistent with the preliminary nature of this study, maximum use was made of available information such as regional transportation models, previous research reports, traffic statistics and documents regarding future plans for the Twin Cities area. A detailed review of literature was made, documenting previous experiments and current studies now underway for other congestion/road pricing programs.

A review was also made of emerging developments in the field of electronic toll collection, which will be important in implementing any road pricing program of the future. This was documented in a separate Technical Memorandum and is summarized subsequently in Chapter 3 of this report.

The study included the inputs of a Steering Committee which was made up of a broad array of governmental agencies and other groups concerned about transportation. Participants in the Steering Committee, and the Project Management Team, are listed in Appendix A to this report. The Study Team participated with the Steering Committee in two extended workshop sessions during the course of the study, which during a limited number of hypothetical pricing options were identified for further analysis. For each of these five categories of options, most of which had several suboptions, the Consultant Team developed estimated impacts on traffic demand, evaluated revenue potential, and developed preliminary estimates of the cost of implementation and operation of the pricing system. The study also addressed other considerations, such as potential impacts on development, potential uses of toll revenue, consistency with regional development goals and so forth.

Finally, the study also included development of a preliminary public information plan. This phase of the study did not actually include a public outreach program; however, the plan for such future public participation was prepared.

Rationale for Congestion/Road Pricing

Over the past 20 years, many metropolitan areas like Minneapolis/St. Paul have experienced deterioration in travel conditions and mobility as congestion has increased and spread to suburban areas. Suburbanization has continued to encourage solo driving and the growth in travel demand has continued to outpace the addition of new capacity. While progress has been made in emissions technology, many urban areas continue to be classified as non-attainment areas and future traffic growth threatens to keep the attainment of air quality standards a difficult goal to sustain.

A significant proportion of new employment in the future is projected to go to suburban locations. At the same time, traditional sources of funding for transportation capacity expansion have become increasingly scarce. Even with additional funds, transit expansion or usual transportation control measures are not likely to reduce or manage traffic in suburban or urban locations. Even where these alternatives dampen traffic congestion at first, many observers believe that growth in latent demand will clog up the roads in a very short time.

These trends promise more and spreading congestion and decreasing mobility in the future. Economic costs of such declines in mobility could be staggering, if innovative approaches to address these problems are not considered. Congestion and/or road pricing theoretically has the potential to play a role in helping the Twin Cities region meet future demands for mobility.

Congestion Pricing - The rationale for congestion pricing derives from the relationship between road capacity, level of traffic and congestion. Overall, transportation systems in most metropolitan areas represent impressive and ample resources. And yet, these road systems are not performing as well as they might. Typically, particular road segments are clogged during morning and evening peak periods on weekdays. Except in a few situations, the problem is not shortage of road capacity in aggregate. Furthermore, plenty of auto capacity is available in terms of seats. The problem is, only a little over one of these seats is utilized. Thus, if some peak period users of congested facilities were persuaded to shift to off-peak times, to higher occupancy modes, or to less congested roads, everyone could be better off. Also, since the relationship between the level of traffic and congestion is nonlinear, relatively small reductions in vehicular flow can produce much more improvement in speed and congestion delays. Shifts by relatively few solo drivers can produce large benefits for others.

In theory, the aim of congestion pricing would be to charge each road trip an amount equal or close to the cost occasioned by the trip. Currently, under congested situations, road users, through existing user charges and taxes pay far less than the costs they occasion. Road users pay for their own running costs and time spent traveling, but pay only for a part of the road system construction, maintenance and operating costs. More importantly, they do not pay for the costs they impose on others, particularly in congested situations, in terms of excess delays, running costs and pollution. Congestion pricing aims to reduce or eliminate these subsidies enjoyed by the peak period road user through surcharges for the use of congested facilities during congested conditions (peak periods).

Congestion pricing can reduce congestion significantly by encouraging peak period travelers to shift to off-peak; to high occupancy modes; to less congested facilities; and even by eliminating certain low value trips. It promises to increase peak period travel speeds; to reduce delays and costs to auto and transit users; to enhance transit productivity and reliability; to reduce pollution and energy use; and to make economic activities more productive. It also is likely to enhance other transportation demand management (TDM) measures such as telecommuting, staggered work hours, and compressed work weeks.

Reductions in traffic produced by transit expansion, high occupancy mode enhancements (HOV lanes), conventional travel demand management strategies, such as parking pricing and management policies may be dissipated over the near term as the latent demand or normal traffic growth fills up the capacity made available. In contrast, congestion pricing has the potential to reduce traffic and sustain the resulting improvements in traffic flows over time.

Congestion pricing also holds the promise of generating revenues well in excess of implementation costs. Despite its great promise, it appears that many institutional and equity issues will need to be addressed before congestion pricing would be adopted widely. The program revenues could help mitigate many of these concerns by enabling funding of alternate mode programs or reducing existing user charges or taxes which appear less equitable.

Road Pricing - As noted previously, there are obviously a number of similarities between congestion and road pricing. The primary difference may lie in the motivation for implementation of the pricing strategy. While congestion pricing would be more heavily focused on its demand management capabilities, road pricing would typically be more heavily oriented toward creating a user fee structure they would assess fees over a broader segment of the region's roadway system, but typically at toll rate levels somewhat lower than those used in congestion pricing.

For example, based on prior research, it might be necessary to establish toll rates of

$0.25 per mile or more to reflect the true cost of delays in severely congested areas, and to have a sufficiently high demand management impact to eliminate the congestion. In contrast, road pricing programs would tend to have toll rates closer to those traditionally in effect on existing toll facilities, where per-mile toll rates range from about $0.03 to $0.10.

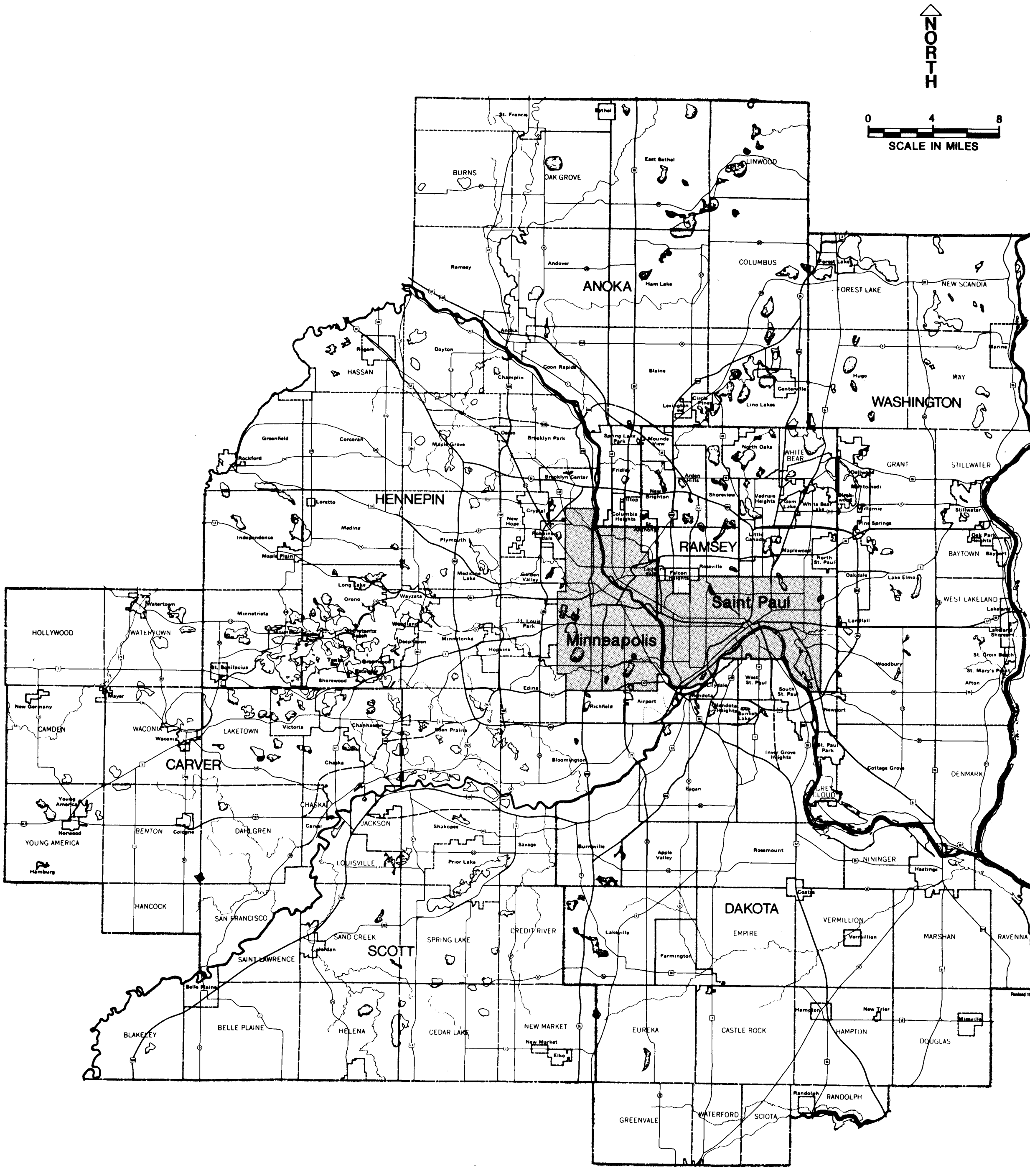
There would be opportunities within a congestion/road pricing system to adjust toll rates by time of day and, perhaps, by geographic location to at least partially influence demand in congested areas. Perhaps more importantly, however, is the potential that at least part of revenues generated under a congestion/road pricing system could be used to finance needed improvements in the transportation system, such as capacity improvements, additional carpool lanes, transit improvements, etc. In theory, the combined effect of price-induced demand reductions and system capacity enhancements financed by congestion/road pricing revenues could provide a strong basis for meeting future demands while still preserving quality of life.

Twin Cities Setting

As shown in Figure 1, the Twin Cities Metropolitan Area of Minneapolis/St. Paul encompasses seven counties, with a 1990 population of 2.24 million people. While area congestion has not reached the critical level experienced in some other major metropolitan areas, there is a great deal of concern that, unless something is done, severe congestion will become inevitable. The following regional statistics point to the continued growth in congestion. During the past 20 years, population grew by 30 percent while vehicle-miles of travel grew by 130 percent. During the same period, even though 170 additional miles of freeways and expressways were built, the regional highway system experienced more than a four-fold increase in the number of miles of severe congestion. Finally, despite improvements in vehicle emissions, the metropolitan area is still considered a non-attainment area for carbon monoxide emissions.

The Metropolitan Council has defined four transportation goals in its Transportation Development Guide/Policy Plan document. These transportation goals, which are intended to influence the achievement of other regional goals, are as follows:

1. The transportation system should be maintained and developed in a manner that contributes to the region's quality of life, furthers the coordination of the major



TWIN CITIES METROPOLITAN AREA

FULL SEVEN COUNTY REGION

BASE MAP COURTESY OF
METROPOLITAN COUNCIL

WILBUR SMITH ASSOCIATES

FIGURE 1

regional systems and supports economic development, consistent with the Metropolitan Development and Investment Framework.

2. Existing transportation services and facilities should be managed, protected, adapted, reconstructed and reconfigured to satisfy travel demand, in the safest practical manner, making the most effective use of limited resources.

3. Transit should be strengthened--regular route, paratransit, and ridesharing options--to maximize the people-carrying capacity of the transportation system, to serve needs of transit-dependent people, to be fully accessible to persons with disabilities, to supplement the metropolitan highway system, to satisfy downtown-oriented travel and to allow for intensified development.

4. Funding levels and sources, including local and private funds, should be adequate and stable to ensure that appropriate investments are made in transportation facilities and services.

The Metropolitan Council's Metropolitan Development and Investment Framework indicates that the Council's regional growth strategy is to encourage growth to occur within the Metropolitan Urban Service Area (MUSA). New development within this area will be supported with regional facilities in line with the Council's forecasts.

Objectives of Congestion/Road Pricing

The Congestion/Road Pricing Study Steering Committee, at a two-day workshop organized by the Project Management Team, (see Appendix A for membership of the Steering Committee and Management Team) discussed the objectives of congestion/road pricing for the region and agreed on the following objectives:

1. Reduce congestion on roadways:
   - Reduce vehicle miles of travel (VMT) during peak periods and/or at congested locations.
   - Convert single occupant vehicle (SOV) use to high occupant vehicle (HOV) use.

2. Increase the economic efficiency of transportation systems:

- Provide savings to travelers by reducing travel time, fuel consumption and other costs.
- Reduce social costs related to pollution, infrastructure maintenance, medical care and public safety.

3. Improve air quality:

   - Reduce vehicle emissions.

4. Stabilize transportation financing:

   - Produce revenues to meet needs for transportation facilities and services.
   - Reduce the need for future roadway system expansion.

5. Support regional growth management policies:

   - Encourage development within the metropolitan urban service area (MUSA).
   - Improve regional access for central city/inner ring residents.

Federal Pilot Program

Growing interest in congestion pricing is reflected in Section 1012 (b) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). In this section, the Congress authorized a Congestion Pricing Pilot Program which will provide operational tests of congestion pricing measures on highway facilities in the U.S. Section 1012 (b) of the ISTEA requires the Secretary of Transportation to "solicit the participation of State and local governments and public authorities for one or more congestion pricing pilot projects."

The primary reason for the Congressional action was that testimony before Congress had emphasized that the Nation's transportation system (particularly in urban areas) was facing some key problems. Congestion was increasing, spreading to suburbs and resulting in massive delays (on the order of 20 billion hours per year) with a corresponding large detrimental impact on economic productivity. At the same time, air quality problems were expected to get worse at a time when revenues available for alternative modes were becoming increasingly scarce.

Clearly, many of these factors were taken into consideration in the development of ISTEA. There was apparently a strong feeling within Congress that innovations like congestion pricing may be needed to provide solutions in many urban areas; solutions aimed at reducing congestion and emissions, generating additional revenues and increasing economic productivity through reduced delays.

Section 1012 (b) of the ISTEA provides funding and authorization for up to five congestion pricing pilot program cooperative agreements involving state and local governments. A maximum of $25 million is available each fiscal year from 1992 to 1997 under the program (for a total of $150 million), with no more than $15 million for any one agreement (single or multiple projects - maximum available for any one agreement is limited to $45 million). More than one project can be carried out under a cooperative agreement between the Secretary of Transportation and project sponsors.

Eligible projects include pricing of roads, highways, freeways, arterials and streets for purposes of reducing traffic congestion. Up to three of the five pilot programs may involve tolling on the Interstate System, notwithstanding long standing bans on tolling of interstate segments, as per 23 U.S.C. 129 and 301. Reductions in established tolls and fees for road use, whether for carpools, transit, low-emission vehicles or other modes of travel, are not eligible for funding. This is particularly important in the Twin Cities context since a high proportion of the major urban freeway system is designated as "Interstate." Parking pricing programs are not eligible. The exception to the rule is if parking pricing or reduced tolls and fees are combined with increased prices for solo driving and/or peak period vehicle travel. In short, price increases for vehicle use at congested times and places are necessary under the pilot program, whether new pricing or boosts in existing pricing, tolls or fees.

A primary consideration in evaluating pilot program proposals will be the prospect of reducing congestion. Reduced congestion also may bring other benefits, including improved air quality, reduced accidents and noise, improved business productivity and increased property values. It is important to consider these possible benefits in designing a pilot program and preparing an application. However, all else being equal, proposals with the most promise to reduce congestion will receive top priority consideration.

The severity of congestion is an important but not critical consideration. Congestion pricing in areas with severe congestion may bring more immediate benefits and be more acceptable to travelers and decision makers. But areas without severe congestion are not excluded from applying, provided at least some severe congestion now occurs and worse traffic conditions are likely in the future. In any case, proposed pricing levels must be sufficient to reduce congestion, not merely raise revenues.

Pilot program funds may be used in direct support of program implementation and evaluation. Funds may be used for design and planning, including detailed assessments of probable impacts, preparation of enabling legislation, enforcement planning, public relations and consensus building, technology assessments and specification, revenue forecasting and finance plans, and other work necessary to specify program operations. During implementation, funds may be used to support general administration and operations, enforcement, pricing mechanisms (e.g. special permits or automatic vehicle identification), monitoring of traffic and transit use, and gathering of reactions from affected parties. Pilot program funds may not be used to support transit operations or capital during implementation. Strong support for monitoring and evaluation is provided for under the pilot program, since the program is intended to draw lessons useful to states and localities other than the sponsor.

Concepts of interest include pricing of roads, highways, freeways, arterials and streets for purposes of reducing traffic congestion, whether individually or collectively. Single facility pricing may involve a bridge, tunnel, highway, arterial, freeway or intersection. Multiple facility pricing may take place in a corridor or areawide. Corridor pricing might include a major highway and parallel arterials. Areawide pricing would include pricing for entering (or traveling within) a network of highways or streets.

The Federal Highway Administration (FHWA) has developed official guidelines for the Congestion Pricing Pilot Program. The guidelines have been published in the Federal Register. An initial Notice announcing the program and soliciting public comment on a number of implementation issues was issued on May 29, 1992 (57 FR 22857). A second Notice, issued on November 24, 1992, presented program guidelines and solicited applications for participation in the Pilot Program (57 FR 55293). A third Notice, issued on June 16, 1993 (58 FR 33293) summarized the response to the November 24 Notice (one of the 16 proposals was accepted for funding) and extended the solicitation period for an additional four months from the date of the notice. Several revised proposals were received in response to the extension. They are currently under review.

While the final decision is still pending, the indications are that the five congestion pricing slots mandated by the Congress under ISTEA are not likely to be filled from the current applicants. FHWA along with the relevant Congressional Committees are in the process of charting the future directions. Early indications suggest:

- The solicitation will be kept open indefinitely;
- FHWA probably will nurture and support potential comprehensive congestion pricing projects that may take several years before full implementation; and
- FHWA probably will fund pre-implementation activities at selected sites with serious intention about implementing road/congestion pricing in the future

In evaluating proposals for participation in the Pilot Program, the FHWA is giving priority to proposals which involve:

- Significant charges aimed at curbing auto use at congested times and places.
- Comprehensive applications of congestion pricing, including pricing of core area streets, of principal segments of the freeway network, major facilities in a corridor, and combinations of congestion and parking pricing. More narrow applications, such as pricing of bottlenecks or single facilities also will be considered if prices are significant.
- Congestion pricing as part of a broad program addressing congestion, mobility, air quality and energy conservation.
- Participation of public, business, rideshare and other affected parties in planning for anticipating and overcoming possible implementation hurdles.
- The likelihood of early implementation of pricing projects to allow for evaluation during the life of ISTEA.
- Availability of reasonable transportation alternatives to peak period auto use, including transit, ridesharing, alternative routes and alternative work hours.
- Well designed monitoring and evaluation programs documenting pricing effects, operations, costs, revenues and community impacts.
- Use of advanced electronic toll and traffic management (ETTM) technologies
- Sound financial and management plans.
- Good prospects for adding to knowledge about design, implementation, effectiveness, operations and acceptability of congestion pricing.

In this context, should it be deemed worthwhile, a Twin Cities congestion pricing initiatives/proposal would stand an excellent chance of obtaining federal pilot program funds for the detailed design, impact assessment, public outreach and other pre-implementation activities in the next phase.

Legal Considerations

There are a number of regulatory and other legal limitations which may come into play with respect to congestion/road pricing concepts. An overview of relevant state and federal legislation is provided below.

Minnesota Legislation - While there presently is no specific state legislation that relates directly to congestion/road pricing as a demand management strategy, the State Legislature did enact a law in 1993 authorizing road authorities to develop, finance, design, construct, improve, rehabilitate, own, and operate toll facilities and to enter into agreements with private operators for the construction, maintenance, and operation of toll facilities. Following are some key provisions of the law:

- No road authority and private operator may execute a development agreement without the approval of the final agreement by the Commissioner of Transportation.
- The governing body of a county or municipality through which a facility passes may veto the project within 30 days of approval by the Commissioner of Transportation.
- A development agreement for toll facilities may provide for any mode of ownership or operation approved by the road authority, including ownership by the private operator, with or without reversion of title, operation of the facilities under leases or management contracts, toll concessions, build-operate-transfer (BOT), or build-transfer-operate (BTO) facilities.
- Residual toll revenues after payments are made belong to the private operator.
- After expiration of a lease for a BTO facility, or after title has reverted for a BOT facility, the road authority may continue to charge tolls for the facility.
- To provide money to acquire, develop, finance, design, construct, improve, rehabilitate, and operate a toll facility and to establish a reserve for bonds issued, the Commissioner of Finance, or a road authority by resolution of its governing body, may authorize, issue, and sell revenue bonds payable solely from all or a portion of the revenues derived from a toll facility, including any payments agreed to be made by a private operator.
- When a highway project in the metropolitan area has been scheduled in the department's six-year work program but is designated as a toll facility, the Commissioner of Transportation shall substitute in the work program a similar highway project in the metropolitan area.

Federal Legislation

Both the FHWA and UMTA legal counsels provided legal opinions in the 1970s suggesting that carefully designed road pricing schemes could be legally feasible. Federal statutes have undergone revisions in the last few years, probably making it less difficult to implement road pricing.

On federally assisted facilities, either for existing facilities, or for facilities now under construction, Federal law appears to prohibit collecting tolls. However, in the 1970s, the Federal UMTA and FHWA legal counsels were of the opinion that Federal statutes might allow states or local agencies to apply road pricing if the fees were not collected at the time and place of passage. Fees for use collected elsewhere, such as state level registration fees and gasoline taxes are obviously permitted, and road use without paying such fees is illegal. Likewise, state weight-distance taxes, in which heavy trucks pay for their actual miles of travel within a state, have been found to be constitutional and legal under Federal laws. Further steps should include soliciting up-to-date legal opinions from US DOT and Minnesota legal counsels.

Road pricing via supplementary visual permits or AVI, in which the financial transactions take place elsewhere might thus currently be legal. This issue needs further clarification. Another possibility is to develop Federal legislation that would specifically exclude particular facilities from any potentially applicable restrictions. If Minnesota policymakers decided to seek federal funding for a possible congestion/road pricing program under the ISTEA Section 1210 (b) Pilot Program, and if the application were accepted by FHWA, then this issue of restriction of tolls on federal roads would become moot since ISTEA specifically exempts Pilot Program participants from the restrictions.

Another issue relates to the restrictions on the use of revenues generated from pricing. Clearly, US Code 23 places many restrictions on the use of toll revenues. This may foreclose the possibility of using revenues in the most acceptable manner from the local standpoint. While the ISTEA Congestion Pricing Pilot Program allows much more flexible use of toll revenues, some limitations do remain. This issue needs more careful assessment.

Chapter 2
OVERVIEW OF EXISTING AND PLANNED ROAD PRICING PROGRAMS

Road pricing systems in the United States have generally been limited to traditional toll facility applications, where the revenues generated from facility user fees are dedicated to the financing, operations and maintenance of the road. That is, the primary motivational factor is revenue collection, not demand management/travel behavior modification. Toll charges are typically constant throughout the course of the day and peak period surcharges are normally not applied. The truer form of congestion pricing, in contrast, is designed to influence travel decisions to the extent that the particular trip is not made, is made at a different time or may be made by a mode other than the single-occupant automobile.

Peak period pricing is not a new concept in the field of transportation, nor is it an uncommon idea. The provision of services, and capacity, to satisfy a peak demand often disproportionately increases the total cost of providing the service. To recognize this, peak period surcharges are commonly applied in the provision of other services, such as telephone, fuel and electricity. Most commuter rail facilities also charge differential fares for time or direction of travel. These charges recognize both the elasticity of demand at different times of day and the necessity of influencing behavior to reduce the cost of providing services. Electronic toll collection technology has now advanced to a level such that road pricing can be economically implemented.

There have been a limited number of road pricing schemes implemented in the past which were at least, in part, aimed at reducing congestion or other modifications to demand. All of these, however, are outside the United States, and include:

- Singapore Area Licensing Scheme;
- Hong Kong Electronic Road Pricing Program;
- Norway-Bergen, Oslo and Trondheim Toll Rings;
- The Swiss Motorway System; and
- The A-1 Motorway System in France.

There are a number of planned road pricing systems now under study in both the United States and abroad. In addition to this preliminary study of congestion pricing in the Twin Cities area, other U.S. projects include:

- S.R. 91 in Orange County, California;
- The San Francisco-Oakland Bay Bridge Demonstration Project;
- A Proposed Los Angeles Basin Pricing Project; and
- Preliminary Studies of Congestion Pricing in the Seattle-Tacoma Washington Area.

There is also considerable planning for future road pricing projects outside the United States. Some of these include, but are not necessarily limited to:

- London and Cambridge England Congestion Pricing Programs;
- Stockholm Zone D System;
- Truck Road Pricing Program for the German Autobahn System; and
- Establishment of a Nationwide Road Pricing System on the Existing Toll-Free British Motorway System.

A brief overview of some of the key characteristics of selected existing and/or planned road pricing projects is provided below.

Singapore Area Licensing Scheme

The Singapore system is known as an areawide system. An imaginary cordon was drawn around the Central Business District - an area of about 2.0 square miles. Singapore, a city of 2.5 million, has operated this areawide road pricing program since 1975. The affected zone includes the downtown business area and two congested corridors leading to the city center. In developing the cordon, main considerations were traffic congestion, available opportunities for bypass routes around the area and the availability of space just outside the fringe for parking and shuttle bus operation.

The pricing scheme was originally established to include only the most severe congestion causers. However, for the purpose of simplifying the enforcement process and reducing costs, it was decided to primarily discourage through and inbound trips which constituted the most problematic traffic and created the major part of congestion. It was found sufficient to monitor only the cordon crossing points, and to focus the charge on the peak traffic only. Additionally, passenger cars with fewer than four occupants were required to purchase paper licensing for placement on windshields for travel into the priced area. Large carpools were excluded from the charge. In addition, all public transportation vehicles, buses, taxis and emergency vehicles were also excluded. Light trucks were excluded, although heavy trucks were completely prohibited from entering the zone during the morning peak. By 1989 all exemptions on private vehicles and taxis were removed and only public transportation and emergency vehicles were allowed to travel free.

In 1989 the pricing scheme was expanded to cover afternoon travel as well. However, a single daily license was valid all day, so commuters who had already purchased the license for use in the morning were generally not affected.

In 1979 the initial daily license fee was set at the equivalent of $1.25 (U.S.). There was also a monthly pass available at about $25.00 (U.S.). In 1989 the fees were gradually raised to slightly more than $2.00 (U.S.) per day or $42.00 (U.S.) per month. Income levels in Singapore are about 75 percent of the U.S.

Enforcement is accomplished using traffic wardens at 28 crossing points into the area. The license plate numbers of violators are noted by the enforcers and owners are cited by mail. The fine for an initial offense is about $25.00 (U.S.), but is increased sharply for repeat offenders. Photographic surveillance has also been introduced.

The system is now about to be converted to an electronic license plate scheme, which will eliminate the need for visual enforcement. They are now underway with development of the system which is expected to be in full operation by 1995.

The congestion pricing program, in conjunction with certain other demand management strategies, has been extremely effective in reducing demand within the Singapore Central Business District. The program reduced peak period traffic volume entering the area by over 40 percent, based on some accounts. Before the pricing program was implemented, the level of service on major facilities in the affected area was very low, generally considered Level of Service F, and speeds on principal routes in the area was about 8 MPH. After implementation of the pricing program, traffic moved more freely and average speeds more than doubled. On the other hand, traffic on peripheral bypass roads increased considerably as through trips were diverted to outlying routes.

Numerous factors led to the successful implementation of the program, including:

- Existence of severe congestion;
- Significant accompanying expansion of transit services;
- A carefully designed and conducted public outreach program;
- Careful timing of the program coinciding with attractive economic and land use reform, including the opening of large scale new public housing and massive slum removal programs;
- Lack of serious legal impediments; and
- A strong authoritarian government.

It was reported that the congestion pricing program has apparently not measurably affected business activity within the affected area and annual revenues from license sales are estimated between $5 and $10 million (U.S.).

Singapore's Area Licensing Scheme was and remains incredibly successful. Its plan is aimed at a 25 percent reduction in Central Area morning traffic; they achieved a 50 percent reduction. Indeed, the Central Area was so free of traffic that congestion delays there were trivial. Bus and auto speeds within the priced zone increased more than 30 percent. However, the congestion levels and speeds deteriorated along the peripheral bypass routes. The overall improvement in regional travel speeds was not as great, however, since the priced area trip portion represented only a small part of total trips in the greater Singapore region.

The large reductions in vehicle trips entering the priced zone during the A.M. peak was more than had been anticipated. Some of the reductions may have been produced by the fact that other policies accompanied area pricing - e.g., parking rates in the priced zone went up significantly and transit service was expanded significantly.

Hong Kong Electronic Road Pricing Program

During 1983-1985, Hong Kong carried out a comprehensive assessment of the potential and feasibility of region-wide congestion pricing using electronic license tags. The objective of the project was to develop an effective and self-financing program for competing traffic congestion by reducing auto traffic at central and inner areas. Commercial vehicles and buses were to be excluded from charges. The program would have also reduced excise and vehicle ownership taxes with excess revenues developed from the pricing program.

After a comprehensive study, a pilot pricing program was introduced in which about 2,600 public service vehicles and volunteer autos were equipped with passive AVI license tags. AVI is a form of electronic toll collection, to be discussed in more detail in Chapter 3. Induction loops were set up in the road bed at 18 strategic locations that the central computer established to process AVI tag information as the vehicles were "charged" road user prices according to location and time of travel.

The pilot program showed that the sophisticated AVI technology for electronic licensing worked efficiently and accurately. The superiority of AVI over supplementary licensing like Singapore was clearly established. The cost of full implementation, including the on-board vehicle equipment, was estimated to be about $30 million back in 1984. The revenue from road pricing was estimated to be many times over the operating cost.

A multiple zone, cordon based pricing system was planned. Proposed charges would have varied by time of day and location. This indicated significant potential economic benefits, more than $100 million per year to road users in terms of reduced congestion, in addition to $50 million in increased revenue to public transportation and up to 17 percent reduction in vehicle emissions.

Despite the promise of strong technical and economic justifications, the full program was ultimately not implemented after the pilot program was completed. Apparently there were numerous reasons leading to the decision not to implement the program on a permanent basis including:

- Government was apparently unprepared for the serious opposition that materialized;
- Auto owners were typically high income and influential persons in Hong Kong who put up strong opposition while the 90 percent of the population who would have benefited, did not organize;
- Congestion pricing was one of the first issues to be brought before a newly established self-rule government, who was eager to establish new found

authority by rejecting any program which had been previously initiated by the Colonial British authority; and perhaps, most importantly;

- There were privacy concerns regarding the ability to identify the time and location of vehicles. This concern was particularly important as the 1997 "pass over" of the Hong Kong territory to China had just been negotiated.

The idea of road pricing is still alive in Hong Kong. The people were petitioned in 1989 by the Hong Kong government about current public opinion about electronic pricing. Continuing concerns about the invasion of privacy and the approach of 1997 (transition of Hong Kong ownership) forced the government to issue a 1990 statement that electronic pricing was under consideration as a long-term option as it monitors developments and applications globally. As an initial step into electronic technology, however, two systems of electronic toll collection were implemented in 1992 at the Aberdeen and Cross Harbor Tunnels.

Norway Toll Rings

The three largest cities in Norway have implemented cordons around the city centers for the purposes of collecting tolls to enter the Central Business District areas. Oslo is the heaviest populated, with 500,000 people. Bergen is the second largest, with about 200,000 residents, followed by Trondheim at 140,000 people. In 1984, faced with national funding constraints that would have stretched the completion of needed comprehensive transportation improvements to more than 30 years, the city of Bergen first developed the idea of a toll ring concept. Oslo followed in February 1990 and Trondheim in October 1991.

From its inception, the toll ring concept in Norway has been based on revenue generated for use in transportation infrastructure improvements, not necessarily direct demand management. Eighty percent of the net revenues from the Oslo system is earmarked for highway improvements and 20 percent are dedicated to construction and improvements for busways. Revenues from the Trondheim system are also used for programs to promote public transportation, bicycling and walking.

The Oslo system is, in a sense, a traditional toll collection system in that it has no peak and off-peak pricing differentials. It differs from a traditional toll application, however, in that it involves the charging of tolls in an entire area, on roads which were not originally financed as toll facilities. The Trondheim system attempts some measure of off-peak discounts, to encourage changes in travel time. A combination of electronic and manual toll collection is used at most locations. Enforcement in the electronic lanes is accomplished by videotaping. Violators are mailed fines approximately equal to the cost of a monthly pass.

Traffic reduction was not a stated goal in any of the three systems in Norway, and the tolls have had minor impacts. In Oslo, for example, before and after studies suggest a traffic reduction of about 3.5 percent. Impacts at the other cities were somewhat lower. Peak period travel is generally less impacted than off-peak travel. The toll for entry into the protected areas ranges from about $0.80 (U.S.) in Bergen to $1.60 (U.S.) in Oslo and Trondheim. It is interesting to note that public opinion surveys conducted in Bergen before the toll ring was opened found that 54 percent strongly opposed the tolls. One year after implementation, however, a survey found that more than half of the respondents favored the system and only 37 percent were opposed. Public fears of congestion at toll plazas failed to materialize and infrastructure improvements financed by the tolls helped to show immediate benefits.

In Oslo, most people surveyed after the tolls were implemented still opposed the project, but with some slight improvement in public opinion. In Trondheim, 72 percent of the people surveyed were opposed to tolls before implementation, this dropped to about 48 percent after the tolls were actually implemented.

Other Recent and Planned European Road Pricing Concepts

Switzerland implemented a motorway road pricing system based on a visually read vignette, or windshield decal. Vignettes can be purchased at points of entry into Switzerland or at various selected locations throughout the location. It is understood that vignettes can be purchased on a daily, monthly or annual basis and are not directly related to time of day or actual distance traveled.

While the system has been considered a success within Switzerland, most other European countries that are now actively considering implementation of road pricing have rejected the vignette concept in favor of more direct electronic charging techniques. For example, the United Kingdom has recently issued a policy statement advising of its intent to implement road pricing throughout the Motorway System by 1997. They will begin testing of alternative electronic toll needs to accomplish this during 1994 and 1995. Similar conclusions have also been reached in the Netherlands. Most existing European toll facilities already use a combination of conventional and electronic toll collection.

In Germany, the government recently announced a proposal to charge road pricing to commercial vehicles only. This is intended to overcome significant inequities in the share of road finance, which is currently borne by passenger cars under Germany's taxing structure. Germany is contemplating use of the vignette system, now used in Switzerland, since the charges will apply only to commercial vehicles.

S.R. 91 Express Lanes - Orange County, California

S.R. 91 is a heavily congested eight-lane, limited-access facility connecting Orange and Los Angeles Counties with San Bernardino and Riverside Counties. Also known as the Inland Empire, these counties have experienced exceptional levels of population growth over the last two decades, with each county listed among the fastest growing in the United States. Development patterns in the Inland Empire are primarily residential, while major employment centers exist in Orange and Los Angeles Counties to the west.

As such, there is a huge and ever growing commuter movement between Riverside County and Orange County along S.R. 91. Traffic on the route increased from about 91,000 vehicles per day in 1980 to well over 200,000 vehicles per day by 1991, an average annual increase of better than 8.0 percent per year, compounded. As a result, extremely high levels of congestion are routinely experienced, particularly westbound in the morning and eastbound in the afternoon. Commuters leave their homes extremely early in the morning, with the morning peak hour beginning at about 5:00 a.m. and continuing until after 9:00 a.m.

Congestion problems on S.R. 91 are exacerbated by the lack of alternative routes due to topographic constraints. The nearest competing freeways or major arterials are 10 miles away to the north and about 20 miles away to the south.

As part of California's landmark privatization legislation referred to as AB680, the California Private Transportation Company (CPTC) was awarded a franchise to construct a congestion priced roadway in the median of the existing congested S.R. 91 freeway. The CPTC project will add four travel lanes, two in each direction, over a 10-mile segment between Riverside and Orange Counties. There will be no intermediate access points and only through trips will be able to use the tolled lanes. No toll plazas will be constructed and toll collection will be 100 percent electronic, with all vehicles to be equipped with transponders on the vehicle windshield. Vehicles with three or more occupants will be allowed toll-free travel during at least the first two years of operation and, as a minimum, discounts from non-HOV toll rates in later years.

The CPTC project will monitor congestion levels on the adjacent toll-free lanes on S.R. 91 and will charge tolls accordingly. With the use of electronic toll collection techniques, variable toll pricing is possible, with tolls changing by time of day and travel direction. Based on traffic and revenue studies conducted for the project, toll rates are estimated to range from as low as $0.25 during off-peak times to as much as $2.50 during peak weekday congestion conditions. This project, which is now under construction and is scheduled to open in 1996, will be an excellent example of not only congestion pricing but also fully electronic toll collection techniques which will be an essential ingredient in virtually all future road pricing projects in the United States and abroad.

London and Cambridge, England Proposals

Congestion pricing has long been considered in and around London. As early as the mid-1970s, plans were developed for various types of pricing schemes, generally using daily or monthly passes.

In 1990, the study conducted by the National Economic Development Office indicated that 62 percent of Londoners would support road pricing as part of an integrated plan of transportation improvements. In early 1992, the British Ministry of Transport revived the congestion pricing concept and initiated a five-year feasibility study. The study, which is now underway, will assess the feasibility of implementing congestion pricing within the area bounded by the M-25, a motorway encircling the greater London area. It will also evaluate options in variation on charges by location, time of day, day of week, vehicle type and different methods of measuring congestion.

In addition to congestion, economic efficiency and revenue potential have become key objectives. AVI technology is under serious consideration, both in the London context and at the national level as the British contemplate plans for placing tolls on the entire interurban Motorway System. The major focus on the London study is on public interaction/outreach, so as to develop a package of improvements that would meet public support. Considerable effort is being put into attitudinal surveys to find out what needs to be packaged with congestion pricing to make it acceptable to the public at large.

In the city of Cambridge, traffic grew by almost 50 percent between 1980 and 1990. Traffic is projected to have increased by another 40 percent by the year 2000. Peak period speeds in the city have reportedly been reduced to an average of just 12 MPH. As part of a comprehensive transportation package, the Cambridge City Council has decided to consider congestion pricing as a demand management instrument. A congestion metering plan was preferred over a general areawide pricing program based on the premise that an areawide program would greater limit the developments that would occur within the protected zone. The proposed system was to be developed under the Pricing and Monitoring Electronically of Automobiles (PAMELA) project, one of the European community's projects under the Dedicated Road Infrastructure for Vehicle Safety (DRIVE) Research Program. Following a recent change in government in Cambridge, the project is apparently currently under review. One interesting aspect of the Cambridge proposal is that charging might not actually be implemented unless there was actually some level of congestion on the street system. The level of congestion in the road network would be measured based on the vehicle speed over a pre-determined distance or the number of stops experienced over a given distance. Under this concept, the charges would accrue even as the vehicle sits in gridlock, with no possible escape routes.

Stockholm Zone Fee

In 1992, agreement was reached on a master plan for transportation investments in the Stockholm region. Implementation of the plan, referred to as the Dennis Agreement, would improve environmental conditions, reduce congestion, and better provide prospects for regional development. Key components of the Dennis Agreement include:

- Upgrading and expanding the already expensive and widely used public transport system in the Stockholm region;
- Constructing peripheral freeways (most notably a ring road and the Western Bypass) to carry traffic around, rather than through, Central Stockholm;

- Reduction of roadway capacity within Central Stockholm to further discourage vehicular traffic to and through the city; and

- The use of a toll-based roadway pricing system to discourage vehicular travel into Central Stockholm, and to finance construction, operation and maintenance of peripheral freeways and other related roadway and environmental improvements.

Implementation of the Zone Fee tolling system is currently scheduled for 1996.

San Francisco-Oakland Bay Bridge Congestion Pricing Project

The Bay Bridge congestion pricing proposal was selected as one of the ISTEA congestion pricing pilot projects by FHWA in the spring of 1993. This project would replace the existing six tolls on the Bridge with variable tolls. Non-carpools would pay a higher toll to travel during congested peak periods, while carpools and vanpools would continue to be able to use the Bridge toll-free. Revenues raised would be applied to improving and expanding options to driving alone in this corridor.

The San Francisco-Oakland Bay Bridge corridor, connecting the East Bay with San Francisco, is one of the most heavily traveled corridors in the nation. Automobiles, bus, truck, ferry and heavy rail operating in this corridor serve more than 135,000 person-trips each day during the morning peak period alone (6:00 to 10:00 a.m.). Tolls are collected in the westbound travel direction only.

The proposed congestion pricing demonstration program is structured such that during specified peak periods when congestion normally occurs, non-HOV traffic will pay an increased price to use the Bridge. Simultaneously, improvements to supporting and parallel transit services and rideshare programs will be made. The hope is that the congestion pricing strategy on the existing toll bridge will be sufficient to push more single-occupant drivers into carpools or expanded transit vehicles.

Summary

In summation, actual experience with congestion pricing has been almost non-existent in the United States and in limited other applications throughout the world.

Without question, however, it is gaining support from transportation planners worldwide, and, as summarized briefly in this Chapter, a number of new projects are moving forth during the 1990s. It is likely, therefore, that by the turn of the century, there will be many operating road pricing systems, including several in the United States.

Chapter 3
TOLL COLLECTION TECHNIQUES

While road pricing has often been considered as a potential mechanism for reducing congestion levels on urban freeways and other routes, the cost and delays associated with the traditional toll collection process has been viewed as a major obstacle. Simply stated, the potential value in terms of reduced congestion of a pricing strategy would be significantly reduced if the collection process itself added congestion and consumed much of the revenue collected through the pricing process.

The emergence of electronic toll collection (ETC) has greatly enhanced the potential viability of congestion pricing. Also referred to as Automatic Vehicle Identification (AVI) or Electronic Tolls and Traffic Management (ETTM), new ETC systems are now in revenue use on several existing toll facilities in the United States and abroad. When considering the potential joint application of revenue collection and the broader field of traffic management and other IVHS applications, several major U.S. and foreign companies have developed ETC systems and a wide range of technological options are now available.

For the most part, the technology exists today to implement most types of congestion/road pricing systems which could be considered in Minnesota. By the time any program were actually implemented, this technology would likely be enhanced significantly, including expanded integration with other intelligent traffic management/information systems.

While there would be a significant cost associated with implementation of a regionwide ETC system, available technology should not be considered a major obstacle to implementation of road pricing. Further, it is reasonable to assume that it may be possible to use fully electronic toll collection, although this would require widespread participation in the pricing program by a majority of vehicles in the Twin Cities area. The cost for on-board transponder devices, in total, will likely dwarf the cost of system implementation, and there still may be exception vehicles which may be unequipped.

It would also be possible to provide limited opportunities for toll collection through conventional means, either automatic or manual, under some of the potential pricing options. This would, of course, increase the cost of operation and potentially result in a significant encroachments on limited right-of-way, etc.

Traditional Toll Collection Methods

Prior to the advent of electronic toll collection, revenues on toll facilities were collected through manual means, for the most part, with some use of automatic coin machines. Traditional toll collection methods have included open barrier type collection as well as closed ticket systems.

Depending on the scope of application of potential road pricing programs in the Twin Cities area, it may be necessary to consider at least partial traditional toll collection methods. If, for example, the scope of pricing application were limited in nature, it might not be practical to equip a majority of vehicles in the region for electronic toll collection. Provisions would also need to be made for pricing of out-of-area vehicles or motorists who use the priced facilities on a less frequent basis.

As the name implies, manual toll collection involves the use of toll attendants in toll booths to actually collect and manually classify vehicle tolls. In a typical barrier plaza application, all vehicles of the same classification would typically pay the same toll rate. In some cases, where toll levels are sufficiently low, it may be possible to use automatic coin machines in certain lanes, thereby eliminating the need for attendants in those lanes. However, automatic lanes are typically limited to passenger car motorists with exact change.

More sophisticated automatic coin machines are capable of actually making change and issuing receipts to patrons. Recent advances in both the United States and abroad have integrated magnetic stripe card readers in automatic coin machines (as well as in manual lanes.) In some cases these magnetic stripe cards can be used as pre-paid fare cards, with stored balance information on the magnetic stripe, decremented with each succeeding trip through the toll plaza.

In some cases, it is necessary to establish toll plazas on ramps or other relatively low volume locations. Some toll agencies have elected to collect tolls at these locations using an "honor system," providing only an automatic coin machine and requiring motorists to have exact change. In some cases, the "violation rate" in these unattended automatic lanes can be quite high, ranging from about 25 percent to as much as 65 percent of passing vehicles. At low volume locations, however, even with a high violation rate, unattended toll collection is sometimes merited on a net revenue basis. The operating costs associated with adding toll attendants at some locations can be significantly greater than the potential revenue loss, even at relatively high levels of toll evasion.

In the Minnesota congestion pricing application, traditional toll plazas may be considered under spot pricing concepts or, other such limited pricing applications where it may not be feasible to equip most vehicles for fully electronic toll collection. Ramp toll facilities might be viable on new toll roads which might be constructed, but would not appear to be advisable under any regionwide road pricing system.

By far the preferred alternative would be implementation of a full electronic toll collection system as described below. During the study it was determined that the more broad the application of pricing, the more viable it would be to implement a fully electronic revenue collection system. As more and more limited access facilities are added to the list of priced projects, total toll revenue potential increases significantly. With this considerable revenue potential, it would be theoretically possible to equip a majority of vehicles in the region, even if this expense was not passed on to users.

By contrast, a limited application such as tolls on one or more particular toll bridge, would not lend itself to full regional wide equipping of vehicles for electronic toll collection. However, electronic tolls should be made available to those who choose to participate at all tolling locations, even if traditional means are also used.

ETC Overview

Generally speaking, the concept of electronic toll collection is simple. In all existing systems now in use, motorists choosing to participate in an electronic toll program enroll in the program and make a pre-payment. They are issued a transponder device which is mounted on or in the vehicle. As the vehicle passes through a toll plaza (or in some cases around a toll plaza in bypass lanes) the appropriate toll fare is simply deducted from the pre-paid account balances.

ETC systems have been in the development stage for more than 15 years. Current generation ETC systems are presently in use in 10 toll agencies in the United States as well as several facilities overseas.

U.S. toll facilities currently using modern generation ETC systems include:

- Dallas North Tollway;
- Harris County toll facilities;
- E-470 Toll Highway (Denver);
- Foothill Transportation Corridor (Orange County, California);
- Oklahoma Turnpike System (10 Turnpikes);
- Lake Ponchetrain Causeway;
- Crescent City Connection Bridge (New Orleans);
- New York State Thruway;
- Lincoln Tunnel (New York); and
- The Georgia-400 Tollway.

In addition, optical laser systems are in use in Maryland, Florida and the Philadelphia area. These systems generally use bar-coded labels, mounted on the vehicle window, and are used to identify patrons eligible for discounted tolls. The bar-code systems have limited potential in a regional congestion pricing system, due to the multiple lane environments and fully non-stop applications which would be needed.

System Categories

ETC systems may be generally grouped into one of three categories, including:

- **Read-Only** - A read-only system utilizes a transponder which is permanently encoded with a specific account number and/or other information and the contents of the on-board device is not in any way altered as each ETC transaction is processed;

- **Read-Write** - Read-write ETC systems operate with some portion of the transponder information being physically "rewritten" as each ETC transaction takes place. There are several variations on the read-write concept ranging from simple storage of "live" data from the current transaction only to maintaining "stored balances" with respect to patron accounts; and

- **<u>Programmable Read-Write</u>** - Programmable read-write systems are presently the most sophisticated type of system available, and provides an opportunity for the patron to directly interact with the transponder device. Again there are a wide range of manners in which this is possible, including small key pads and, most often, interface for credit cards and smart cards.

Each of the systems listed above currently in use in the United States utilizes one form or another of the read-only concept. As might be expected, read-only systems feature the lowest cost for individual transponders, but also require account information to be centrally maintained. Each time the vehicle equipped with a read-only tag passes through the toll collection location, the appropriate toll charge is deducted from the account balances maintained in the computer data base. The on-board device is used only for identification of the vehicle and ETC account number. This arrangement can result in considerable overhead for the operating agency, as large volumes of transaction data must be communicated and processed daily. On the other hand, read-only systems have the advantage of an easy account balance replenishment process, which can be handled by mail, at conveniently located service centers, through direct linkage to credit cards, electronic funds transfers, etc.

On those read-write systems which maintain "stored balances" in the transponder, it is not typically necessary for the agency to maintain independent listings of balances on off-line computer systems. This reduces overhead but does reduce the number of options available for renewal. Since the only official record of the remaining balance is stored in the transponder itself, it is necessary to physically bring the transponder unit to the point of account replenishment.

In a traditional toll application, this can be accomplished in a manual toll lane. Under a congestion pricing system, where most "toll collection" would typically happen in a fully unattended environment, it will be more difficult to provide locations for convenient replenishment of transponder accounts.

Another disadvantage of the stored balance arrangement is that a separate balance will need to be maintained on each transponder, even if a single account has multiple transponders. Consider, for example, commercial vehicle accounts which may have several hundred vehicles. A minimum balance, of say, $100, might be required for each of the several hundred vehicles which may prove to be a significant problem for commercial vehicle operators. Under an account-based system, a balance for the entire fleet could be maintained at a single location.

It is also possible to use read-write technology without actually maintaining balances on the transponder itself. One major advantage is that information about the transaction in process can be "written" at a point of entry and exit to and from a "priced" facility. For example, suppose tolls were to be implemented on the freeway system on all or certain portions of the Minneapolis-St. Paul area. Further suppose that the actual price charged would be a function of point of entry and exit from the freeway system. A simplified read-write tag would allow the point of entry to be written onto the tag itself at the time the vehicle enters the system. The appropriate toll could then be calculated at the point of exit, real-time, by simply comparing the point of entry (as written on the tag) with the point of exit information.

The most advanced systems will allow a greater level of direct user interface. Many of the ETC manufacturers are now beginning to offer programmable read-write devices. These are in more widespread use in Europe, particularly in France and Italy where Smart Card interfaces are widely used.

There are several advantages to this type of system. First of all, it provides a "feedback" mechanism to the user regarding the amount of balance remaining, upcoming toll charges, etc. It also permits pre-paid balances to be stored on a Smart Card, for example, which can be more easily brought to a point of replenishment, such as at banks, shopping malls, etc. It is not necessary for the entire transponder device to be brought to the particular location. It provides an additional measure of security, since the transponder would be inoperable without the Smart Card and/or credit card and, perhaps, most importantly, the more sophisticated transponder device may be more adaptable to future traffic management and information systems which will undoubtedly emerge.

As might be expected, the more complex the transponder, the more expensive. While there are several hundred thousand transponder devices now in use in the United States alone, they are all of the read-only variety and it is generally believed that the market is still in its infant stages. It is likely that costs per transponder will decrease significantly in the future. Transponders generally fall within the following price ranges:

- Read-only - $20-$30;
- Read-write: $30-$40; and
- Programmable read-write: $40-$60.

If a regionwide pricing scheme were implemented in the Twin Cities area, it is not unlikely that as much as two million transponders might be required, depending on the nature and extent of the pricing program. In these types of quantities, it is likely that the transponder costs would be significantly reduced, possibly by as much as 25 to 50 percent.

Readers - At each of the toll collection locations, it would be necessary to implement some type of reader system. This generally includes an intelligent interrogator device, some type of antenna device and, for a series of reader locations, controlling computer equipment. It would also probably be necessary to implement some type of video enforcement system at each potential revenue collection location. The video systems are designed to record license plates and other distinguishing information from other vehicles which violate the pricing program. It may also be necessary to provide automatic vehicle classification equipment at each of the pricing locations. Depending on the pricing concept used, toll charges may be different based on the number of vehicle axles, etc. Equipment systems already exist for automatic vehicle classification, although these become somewhat more complex in a multi-lane, open-road environment. It would be relatively straightforward to implement a vehicle classification system on, for example, freeway ramps where there is some control over the lateral placement of vehicle tires, etc.

A typical installation, including an antenna, reader, video enforcement system and vehicle classification system would probably be in the range of $25,000. Where multiple lanes are involved, such as freeway mainline sections at points of entry into a priced area, the total equipment cost would be a multiple of the individual per-lane cost, although some efficiencies would be possible.

Central System - If an account-based AVI system is utilized, a large central system, or groups of central systems, would need to be established. It would be at this location(s) where individual account data would be maintained on large computer files. Under this configuration, a complex network of data communications would be needed between the Central System and each of the remote revenue collection locations.

If the system were designed such that balances could be stored on the transponder itself, or on Smart Cards, the amount of actual data flow could be reduced. However, it is likely that on-line communication capability would still be desirable, for purposes of traffic statistical information, fault detection and so forth.

Potential Applications in Congestion/Road Pricing

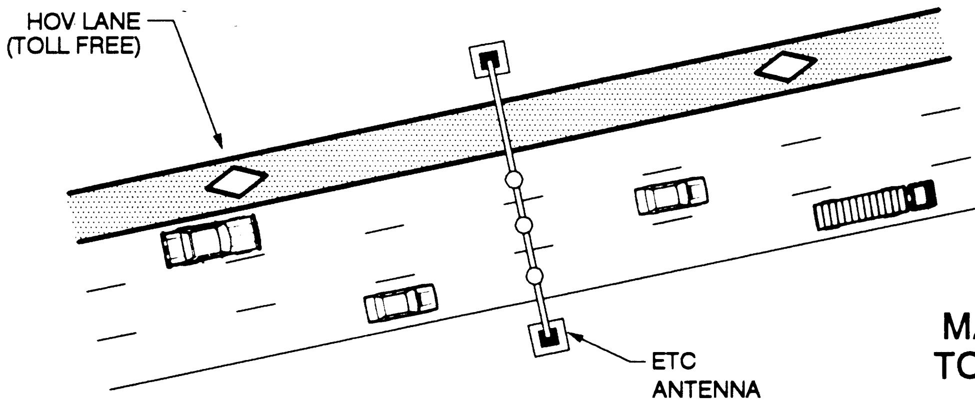
There are a number of possible methods in which congestion/road pricing might be implemented in the Twin Cities area. These will be delineated in subsequent chapters. However, to better understand how electronic and/or traditional toll collection might be applied, a few candidate options are discussed below.

In developing future plans for fully electronic toll systems under other road pricing proposals, two generic concepts have been established. These are generally referred to as the "open" electronic system, and the "closed" electronic system.

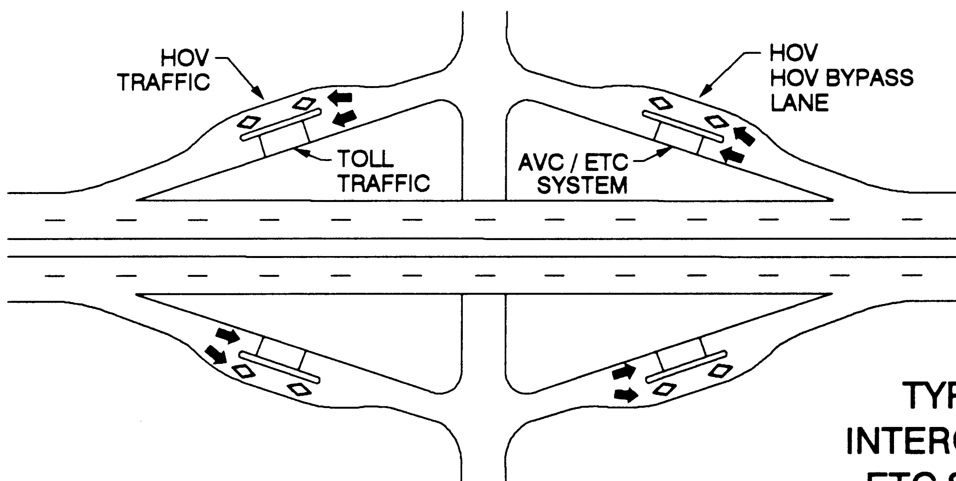
Under the open system, electronic toll antennas or other reading mechanisms would be typically installed over or in the roadway pavement. As shown in the upper portion of Figure 2, antennas would be designed to read the ETC transponders on all vehicles subjected to tolls passing through a multi-lane "tolling zone." This tolling would be done at full freeway speeds. In the example shown in Figure 2, provisions could also be made for toll-free HOV bypass lanes. As will be noted subsequently, all of the hypothetical congestion pricing scenarios evaluated as part of this study assume that multiple-occupant vehicles would be allowed toll-free usage.

Under the open electronic concept, the various electronic tolling readers would be installed in each mainline segment of the freeway system; that is between each interchange. The actual toll associated with each tolling location would be based on the per-mile rate and the distance between the interchanges.

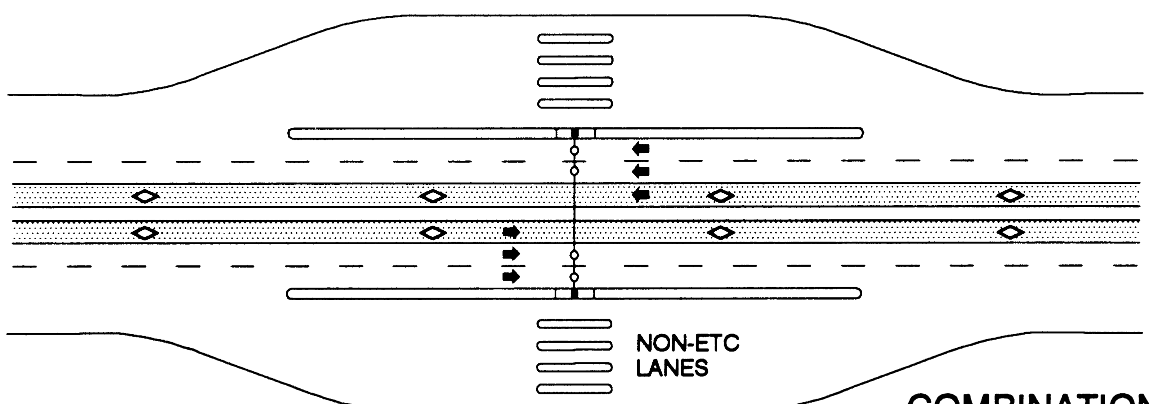
The open tolling concept does, however, present some technological challenges. First of all, multiple ETC transponders would need to be read at high travel speeds. More importantly, in a multi-lane environment, it would be difficult to control the horizontal placement of vehicles passing under the read zone. While this would not necessarily limit



TYPICAL
MAINLINE ETC
TOLLING ZONE



TYPICAL
INTERCHANGE
ETC SYSTEM



COMBINATION
ETC / TRADITIONAL
TOLL PLAZA

AUTOMATED TOLL COLLECTION CONCEPTS

WILBUR SMITH ASSOCIATES

FIGURE 2

the effectiveness of the actual ETC process itself, it would make ancillary functions, such as automatic vehicle classification (AVC) to be extremely difficult. It could also create some problems with video or other types of enforcement system.

Perhaps a preferred alternative to the open tolling concept is the "closed" electronic tolling concept. This would be a viable option under a pricing application which might be applied only to freeways or other limited access facilities. Electronic reading equipment would be established at all entry and exit ramp locations, as well as the end points of a particular freeway. As vehicles enter the freeway system, their point of entry would be noted in the ETC system and, depending on type of transponder, also electronically written on the transponder itself. By providing bypass lanes of the tolling locations on each ramp, it would be possible for HOV traffic to enter or exit the freeway system without being tolled.

Another important advantage of this closed electronic system is that automatic vehicle identification and enforcement would be improved. In most cases, the toll collection process on the ramp can be consolidated to one travel lane, thereby ensuring reasonable levels of control over horizontal vehicle placement, which would allow for automatic vehicle classification. It would also permit improved enforcement, since the travel speed of vehicles on entry and exit ramps would be much lower than actual freeway speeds.

The toll amount would be based simply on the point of entry and the point of exit from the regional freeway system. These rates could vary by roadway segment, such as more congested areas being charged a higher per-mile rate. In addition, by use of minimum tolls, there would be an important disincentive for use of the freeway system for very short trips. This is consistent with the current strategy of ramp meters on the Twin Cities area freeway system. Ramp meters add in "built in" delays, which amount to time penalties, and which, among other things, discourages those making short trips from bothering to use the freeway system. Ramp metering also physically limits the pace at which vehicles enter the freeway system, and can theoretically ensure high levels of service on the freeway mainline itself, while backing up traffic on ramps and into local city streets.

If a regionwide electronic road pricing system was implemented on most or all freeways in the Twin Cities area, it would be appropriate to reassess the advantages of ramp metering. The pricing strategies could be set in such a way as to discourage short trips, thereby achieving much of the same advantages of ramp metering, without backing up traffic onto local streets.

In a more limited pricing application, such as the establishment of tolls on existing or new bridge facilities, it would probably be necessary to provide a combination of traditional and electronic toll collection techniques. As shown in the lower portion of Figure 2, provisions would be made in these toll plazas for full non-stop electronic toll collection for vehicles which are properly equipped. Figure 2 also shows how special bypass lanes could be constructed in the center of the toll plaza for toll-free HOV traffic. Traditional cash toll lanes would also be made available for occasional users and others who did not wish to participate in the electronic pre-payment tolling system.

The combination ETC/traditional toll plaza shown in Figure 2 would also be a good configuration for toll stations which might be constructed at border locations if regionwide freeway pricing was initiated. In that case, vehicles equipped with electronic toll collection would simply pass through the plaza. The non-ETC user, would be accommodated in the outer toll lanes. In this case, under a regionwide pricing system, out of area users would be able to obtain a temporary electronic toll device at the point of entry into the priced area. At the time of exit, the transponder would be surrendered and the appropriate toll charges based on the amount traveled would simply be deducted from pre-paid amounts.

System Planning Issues

In planning electronic toll collection systems, it is important to consider several issues, such as:

Application and Related Functions - The intended application and any desired related function. The nature of the system will be influenced by the nature of the proposed congestion pricing program itself. Flat tolls versus variable tolls may well influence the nature of the system. As importantly, the system should be planned in the context of potentially greater regional IVHS considerations. The electronic toll equipment does, in its most basic sense, provide for communication between the vehicle and the roadside. That same communication linkage can be used for other data flow, including traffic management information, particularly if sophisticated transponders are used which provide opportunities for feedback to the users.

Privacy - Privacy has been often raised as a major potential issue of concern in any electronic toll system. When Hong Kong moved to implement congestion pricing during the mid-1980s, an early generation electronic toll system was tested and implemented. However, before the system was actually put in use, the program was dropped due to political pressures, in part due to widespread public opposition on grounds of invasion of privacy. Simply stated, motorists fear the "big brother" phenomenon where government might have a mechanism for tracking and recording the presence of vehicles.

It should be noted that privacy has been of almost no concern in those systems which have already been implemented in the U.S. on existing toll facilities. In many cases, agencies offer an opportunity for "anonymous" enrollment into the AVI program. They have received very few "takers." Motorists generally prefer the convenience of account linkages to credit cards, etc., and are not particularly concerned about the privacy issue.

At the same time, all the existing systems in current toll operations are "voluntary" in terms of patron participation. Congestion pricing systems may, in the classical sense, not give the patrons much of an option. Hence, if the patrons wish to use major portions of the affected roadway system, they will need to be so equipped. It may no longer appear to be so much a volunteer program.

Obviously, any system with stored balances eliminates the need for actually recording information about the particular vehicle at the time it passes a revenue collection location. The use of Smart Card interfaces can provide an enhanced means of dealing with the privacy issue, by providing capability for stored balances without the need to physically transport the transponder device to the point of account replenishment.

Enforcement - In a fully unattended automatic electronic toll collection environment, enforcement becomes more of a challenge. Most electronic toll systems now being contemplated will utilize some form of video enforcement system. Recently developed technologies permit use of high-resolution video, with license plate images being recorded only when the system is triggered through a violation in an electronic toll lane.

Violation vehicles are then accumulated on computer files. The video enforcement systems are designed such that the license numbers are "machine readable" and human intervention or interpretation is required only in a small minority of the violation cases. Where motorists are determined to have violated, depending on local policy, a fine or administrative fee may be assessed, usually be means of a mail out announcement.

A key issue in enforcement is whether video surveillance is legal in a particular location as a basis of assessing fines. Some states have enacted legislation which specifically identify toll system violations as a unique category. This permits fines to be levied against vehicle owners, based on vehicle registration information, as distinguished from vehicle operators, which are normally the subject of motor vehicle moving violations.

While enforcement will always be an important factor in any electronic toll system, it now appears that the technology to facilitate a high level of system integrity and security does exist. Enforcement issues may more relate to legal and regulatory matters, which will require further research and analysis in future studies in light of Minnesota statutes.

Chapter 4
IDENTIFICATION AND SCREENING OF POTENTIAL PRICING CONCEPTS

A wide range of potential pricing options were identified by the study team. These were evaluated in a two-phase program. Initially, the projects were given a broad screening, including input and comment from the Project Steering Committee. After the benefit of Steering Committee input, the number of options for detailed assessment was reduced. In the second phase of the analysis, estimated traffic, revenue and other implications of each for a reduced number of scenarios were determined.

In this Chapter, a wide range of options are discussed, in general terms. This includes identification of various categories of transportation charges, as well as the various methods of implementation. This Chapter will also discuss critical inputs obtained from the Steering Committee, as well as decisions on the reduced number of potential application options which were evaluated in more detail. Actual results of that analysis are summarized subsequently in Chapter 5.

Methods Used for Transportation Charging

There are a number of methods that are used to collect revenue related to transportation facilities. These methods vary in the extent to which they are directly related to actual transportation system usage.

For purposes of discussion, a total of five categories of transportation revenue raising techniques can be readily identified. In general, the categories range from vehicle related taxes, which have little relation to actual usage, to specific road pricing mechanisms, structured to directly reflect incremental levels of usage. Obviously, the more directly related to road usage, the more likely a particular pricing strategy will be effective in managing demand.

Road Prices Not Related Directly to Use:

- Vehicle registration taxes;
- Vehicle excise taxes; and
- Vehicle personal property taxes.

While increases in such taxes would produce revenues, they are not likely to have an appreciable impact on road use, congestion or pollution. They probably would not produce increased efficiency in the road sector nor would they be equitable in the sense that costs of improvements are borne by those creating these costs. On the other hand, such taxes are easy to administer and are efficient in terms of the cost needed for collection.

Prices Indirectly Related to Road Use - The most notable example of this type of charge is the traditional gasoline tax. The tax is based on a per-gallon or percentage of gross sales price, and therefore, is indirectly related to the amount of road use. The effective user charge is, of course, influenced by the fuel efficiency of the particular vehicle and the type of driving done. As such, the gasoline tax does have the potential to affect road use and emissions to a limited extent, at least over the long term, but the impact on congestion at particular locations is not likely to be significant. Further, gasoline tax prices would probably need to be considerably higher than current levels to have a significant influence on demand reduction.

Prior research suggests a total gas price/demand elasticity of about -0.10. This means for each ten percent increase in total motor fuel costs, a decrease in demand of about 1.0 percent could be experienced. However, at present gasoline taxes generally represent between about 1/4 to 1/3 of the total cost per gallon of fuel. Hence, to achieve a reduction of, say, ten percent in global travel demand total gasoline prices would have to be at least doubled (in real terms - i.e., after factoring in inflation). This would be equivalent to an increase in the gasoline tax of as much as 400 or 500 percent from current levels.

Road Prices Somewhat Related to Road Use - Examples of this category might include registration fees based on vehicle miles of travel; and registration fees based on emission levels.

Some impacts on roadway use and emissions can be expected from such fees. However, impact on congestion at particular locations is not likely to be significant, since these charging mechanisms would be based on total amounts of travel, not necessarily related to the time or location of travel. The concept could be extended to a "dual license" program (e.g., peak versus off-peak) to achieve some congestion relief, but would indeed be a complex undertaking.

Direct Use-Related Charges - This is the category of transportation charging which is the focus of this study. By definition, direct user-related charges would vary in direct proportion to the amount of vehicle or roadway usage. It can also be used to achieve specific goals in congestion reduction in particular areas and/or transfer of travel to different times of day.

Direct use-related charges can be made either for vehicle storage or vehicle movement. Vehicle storage charges, obviously, relate to parking. It would certainly be possible to implement a parking surcharge, for example, in a particular region or zone, to encourage carpooling or otherwise discourage vehicular travel. This could be done in conjunction with HOV pricing discounts or other related incentives.

Parking price increases have been very effective in reducing solo driving among affected parkers. Effectiveness in an areawide or regionwide basis would depend on how many parkers are covered under a particular parking pricing program. For instance, increases in existing parking rates (via rate revisions, peak period supplements or parking revenue taxes) would affect parkers only at paid facilities. In situations when a large proportion of parkers receive subsidized or free parking, parking price increases would need to be packaged with effective subsidy reductions (e.g. "cash out" policies) to achieve high level of trip reductions.

In areas where a significant proportion of parking is available free at private or public unpriced facilities, traditional parking rate charges on revenue taxes would not cover these free spaces, and could suppress the overall effectiveness in terms of reduction in solo driving. In such situations, non-traditional, innovative parking pricing policies can be considered to achieve greater coverage of parkers at free spaces, which in turn, could produce significant reductions in solo trips.

Private and public free spaces (both off- and on-street) could be covered under a parking pricing plan using supplementary parking permits, using windshield stickers, such as programs now in use in Cork, Ireland and several Israeli cities. Under such a policy, all vehicles during peak periods in designated zones would be required to purchase and display monthly or daily stickers. Such a program could cover both public and private, priced and unpriced, off- and on-street spaces and be highly effective in reducing solo driving.

Supplementary parking permits also would enable large areas to be brought under a parking pricing scheme even where traditional parking pricing covers relatively small zones within core areas. New "smart-card" technology holds great promise for use in areawide parking pricing policies, since it promises to allow pricing of vehicles without resorting to meters or controlled parking lots. it should be mentioned, however, that any areawide parking pricing policy covering private spaces would need a special statutory authority to enforce violations at private spaces.

Charges for vehicle movements typically would fall into two broad categories: area entry charges; and direct road use charges. Within each of these broad categories, there are a number of suboptions regarding the particular scope of application. For example, direct road pricing could likely be implemented at a single location, such as a bridge or tunnel, along a particular corridor or over an entire region. Area pricing could be focused on a relatively "tight" congested area, such as in Singapore, or over a more broad area, such as the full Twin Cities area for purposes of encouraging regional development goals.

As noted earlier in this report, direct road user charges can also vary based on primary intent, i.e., congestion pricing (demand management) versus road pricing. The road pricing concept would tend to be a broader based concept, with at least one of the principal objectives being revenue generation. Congestion pricing would probably be considered a sub-category within road pricing, which would focus more specifically on particular congested areas, and would probably involve higher levels of toll charges within those areas with the primary motivation being demand management and overall congestion reduction.

Market-Like Variations - A fifth category of demand management-related pricing options might involve some form of travel rationing or "cashing out" of SOV traffic. In the first case, some type of daily or annual travel allowance would be provided for each motorist. Those who normally use less than their allocation of travel would be free to "sell" this on some type of open market. Therefore, a direct cost would be associated with additional levels of travel above certain thresholds. The concept of "cashing out" primarily relates to work trips, where employers might actually offer cash incentives for employees not to drive to work alone.

These and various other market-like strategies have the potential to reduce congestion without generating much competition from the public on grounds of the inability to pay, double taxation, etc. However, it is necessary to identify new revenue sources for future transportation improvements and, some of the market strategies such as cashing-out could actually result in a net additional cost to the government or individual companies participating in the program.

Summary - If revenue generation were the only objective, any of the above strategies would be pursued. However, since congestion relief is also a goal, the first two categories are not likely to be very effective. On the other hand, the market-like strategies listed above are not likely to produce revenues.

Since the objectives of any potential congestion/road pricing program in the Twin Cities area is to include both demand management and revenue generation, it was clear that the direct road use charges should receive the most attention. Based on discussions with the Steering Committee, it was recognized that parking surcharges could also play an important role, but the study team was requested to devote its full attention to specific road pricing options, at least at this preliminary phase of analysis.

Direct road use charges can be assessed based on distance traveled or as a flat rate for using a particular facility. Charges can also vary by time of day, travel direction and level of congestion.

Scope of Application

The scope of application of direct road user charges can also vary depending on the particular objective. Examples can include:

Spot Locations - Spot locations, such as toll bridges or tunnels. Rivers or other bodies of water serve as a natural constraint to travel. By placing road use charges on some or all crossings of that river or of a particular waterway, it is possible to affect demand management along a broader corridor, without actually pricing all the various roads within that corridor. Pricing could also be applied to isolated bridge locations, both as a method of raising revenue or a particular improvement, such as bridge replacement or expansion, or to influence demand from one crossing to another.

In theory, pricing would also be applied at other spot locations, such as particularly congested interchange ramps or short segment of freeway. The practicality of this application is questionable, however, especially if electronic toll collection is to be used which will require large proportions of the motoring public to be specially equipped.

Specific Facilities/Corridors - The most common existing type of direct road pricing relates to the specific facilities or corridors. All traditional toll roads would fall into this category, where only the particular facility is priced and parallel routes serve as a toll-free alternative. The objective of this type of pricing might be to redistribute demand over all routes within a given corridor. Some facilities provide such a superior advantage over alternative routes, that pricing the route might also emphasize demand management, particularly in terms of encouraging shifts to transit or carpooling. This would be particularly true if revenues generated from the facility pricing program were funneled back into establishment of transportation options, such as transit subsidies, creation of carpool lanes or park-and-ride lots, etc.

Areawide Pricing by Road Category - One of the most logical applications of road pricing would involve charging for use of all roads of a particular category within a particular region. For example, it might be logical to establish road pricing on all limited-access freeways in a particular area. In the case of the Twin Cities, this might include pricing of freeways within the central core area, those routes inside the belt freeway system, those freeways inside the MUSA line or, perhaps, all freeways within the seven-county Twin Cities Metropolitan Area. Consideration could also be given to only assessing pricing on certain strategic freeways which are either heavily congested or which serve traffic to and from major employment centers, etc.

Area Pricing - As noted above, the basic concept of area pricing would involve charging for vehicle entry into the protected area. For example, one option might be to establish a form of "toll ring" around the city centers of Minneapolis and St. Paul. These are obviously major employment centers and by establishing a premium charge for entry into this area, an incentive would be created to carpool or seek transit alternatives.

This concept was discussed at the Steering Committee meetings. It was felt that such a strategy would be geographically inequitable, given the multi-nucleated development pattern in the Minneapolis-St. Paul area. In contrast, the pattern of development in Singapore features a very concentrated core area which was relatively easy to cordon off without introducing major intra-regional inequities.

As an alternative, the Steering Committee suggested that the study team examine the concept of entry tolls for vehicles entering the overall MUSA area. This is a much broader region, and would therefore minimize any potential concerns about inequity within the region. However, it would obviously be less effective in managing demand and reducing congestion, since the larger the area, the more of the total trips which are made entirely within the priced zone. Such trips would not, of course, be subjected to pricing or demand management strategies.

A MUSA area pricing scheme would, however, provide some incentive for future development to take place within the MUSA area, and this would be consistent with regional planning goals.

Potential Uses of Revenue

Needless to say, most road pricing schemes would generate considerable net revenue. The uses of this revenue will directly impact the financial feasibility of the pricing strategy as well as the public acceptability. The study identified potential uses of revenues generated. It was not, however, an objective of this study to recommend a specific usage.

Some potential uses of congestion/road pricing revenue include:

- Financing of needed highway improvements, such as capacity expansions, HOV lane construction, bridge replacements, new highways, etc.;
- HOV initiatives, such as construction of park-and-ride lots, vanpool subsidies and the like;
- Transit capital and/or operating subsidies, again to further encourage shifts from the single-occupant auto to transit;
- Mitigation of pricing impacts on lower income motorists - a portion of the revenue generated could actually be funneled back into a reduction in other types of taxes and/or tax credits for lower income motorists. In this way, the road use charge would be used to actually influence demand, while not necessarily increasing the total tax burden to lower income people; and
- A potentially wide range of non-transportation uses.

It should be recognized that use of congestion/road pricing revenue for non-transportation needs may erode public support for the concept. This appears to have been true based on actual experience in the various Norway toll ring projects and the planned Hong Kong system among others. Potential uses of revenue are discussed in more detail in Chapter 5.

Steering Committee Inputs

As noted previously in Chapter 1, a Steering Committee comprised of over 30 members, in addition to representatives of the Consultant Team, was assembled at the outset of the study to provide a broad range of input from a variety of transportation planners, decision makers and potentially impacted groups. After the full range of congestion/road pricing options had been identified, a two-day meeting was held with the Steering Committee to help identify evaluation criteria, as well as review and screen the broad range of options to a manageable number for continuing analysis. The study team received extremely valuable input from the broad cross-section of interest groups represented on the Steering Committee. At the conclusion of that two-day work session, the following five categories of congestion/road pricing strategies were suggested for further evaluation:

- Pricing at spot locations, including several hypothetical bridge locations within the Twin Cities area;
- Regionwide congestion/road pricing of the freeway system in the Twin Cities area, using an innovative, fully-electronic tolling system;
- Implementation of congestion/road pricing on individual project facilities alone, including one hypothetical new facility which might be constructed as a toll road as well as one existing freeway corridor;
- Pricing strategies directly involving the existing and planned HOV network, as well as two hypothetical LRT corridors of the future; and
- Cordon entry tolls at the boundary of the Metropolitan Urban Service Area (MUSA).

Each of these are described in more detail in Chapter 5, including the results of preliminary traffic, revenue, operational and other impact analyses.

Chapter 5

EVALUATION OF POTENTIAL APPLICATION OPTIONS

A somewhat more detailed, although still preliminary assessment of the feasibility of congestion/road pricing in the Twin Cities area was undertaken for each of the five categories of options identified by the Steering Committee. In most cases, the five categories of pricing concepts involve multiple scenarios. Where possible, each of these was tested using the Twin Cities area computer network and model. In some cases, traffic and revenue impact estimates were estimated manually.

Evaluation Criteria

With input from the Steering Committee, the following evaluation criteria were identified:

- Congestion relief, as measured through:
  - Reduction in single-occupant vehicle (SOV) usage;
  - Congestion reduction as measured through volume/capacity ratios at selected locations; and
  - Improvements in travel time.
- Mode shift potential, including:
  - Potential to increase transit usage; and
  - Potential to increase ridesharing.
- Revenue and cost considerations, including:
  - Total revenue potential; and
  - Ratio of revenue to cost of implementation and operation.
- Operational effectiveness, including:
  - Complexity of administration;
  - Difficulty of enforcement.
- Public/political acceptability, including items such as:
  - Perceived equity (geographic and other);
  - Impacts on low-income travelers;
  - Impact on businesses and development; and
  - Local traffic diversions to alternative routes.
- Air quality impacts, as summarized through an evaluation of:
  - Reduction in vehicle miles of travel (VMT); and
  - Overall improvement in average vehicle operating speeds.
- Development impacts, i.e., the degree to which a particular pricing concept supports regional growth management policies.

Based on the preliminary modeling analysis, it was possible to quantify some of the above evaluation criteria. In other cases, a more subjective comparative analysis was undertaken.

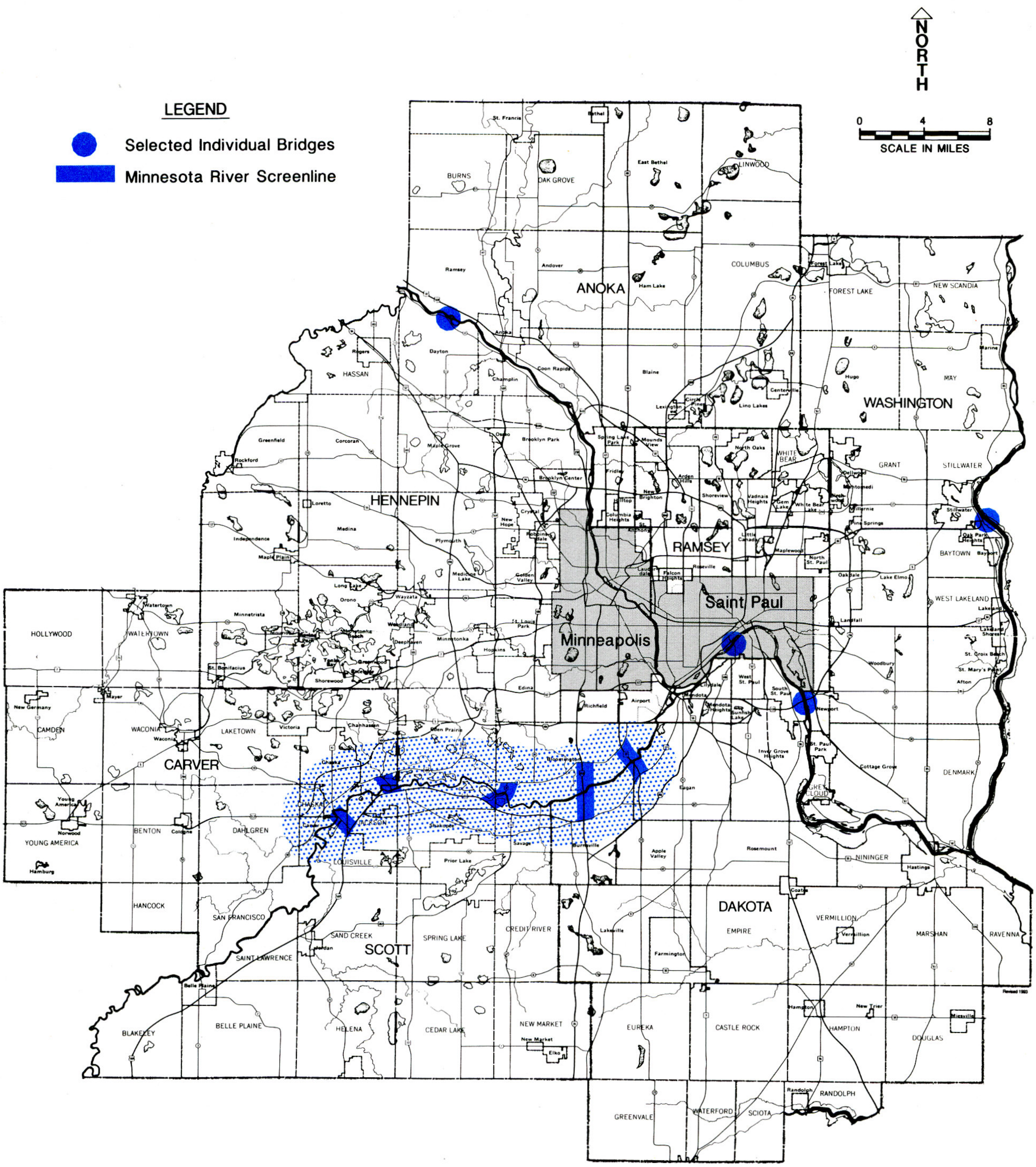
Spot Locations

The first category of congestion/road pricing tested was several potential spot locations. For purposes of this analysis, existing and/or planned new bridges in the Twin Cities area were found to be ideal examples of spot pricing. As shown in Figure 3, four individual bridges were analyzed, along with a screenline of bridges along the Minnesota River south of Minneapolis. The four individual bridges were selected to represent urban vs. suburban conditions, new vs. existing bridges and a planned bridge reconstruction project.

It is important to recognize that the specific projects shown in Figure 3, as well as the facilities tested in all other categories, were for illustrative purposes only. The Steering Committee identified typical projects of one nature or another, simply to ensure that the analysis would provide a meaningful, real-world assessment of revenue potential, traffic impacts, etc. There was no intent to identify actual projects which should be priced, and it should not be inferred that the selection of hypothetical test locations is any indication of recommendations regarding future pricing applications. The hypothetical locations shown in Figure 3, and all other figures in this report, were selected only to provide an opportunity for the reader to better understand the implications of pricing, in a real-world context, without actually identifying the specific projects.

The four individual bridges tested include two existing and two proposed new crossings. The existing bridges include the I-494 crossing of the Mississippi River south of St. Paul and the Wabasha Street Bridge feeding downtown St. Paul. The other two bridges were both proposed new facilities, including the proposed new crossing at Stillwater and a proposed new bridge west of Anoka.

The hypothetical screenline crossing covered all bridges along the Minnesota River between Trunk Highway 41 on the west and Trunk Highway 77 on the east. This hypothetical concept represented both spot pricing and, a form of corridor pricing as all bridges along a particular screenline were tolled.



SPOT LOCATION PRICING

CONGESTION/ROAD PRICING STUDY

BASE MAP COURTESY OF
METROPOLITAN COUNCIL

WILBUR SMITH ASSOCIATES

FIGURE 3

For purposes of this preliminary analysis, it has been assumed that tolls would not be charged to high-occupant passenger vehicles. HOV traffic was assumed to be represented by passenger vehicles with two or more occupants. Tolls would also be assessed to commercial vehicles, regardless of occupancy. A probable exception to this would be buses and/or vanpools.

In the case of these hypothetical bridge tolls, it would probably be necessary to offer both electronic and traditional toll collection options. Tolls could be collected in one or both directions, depending on location and the level of traffic divertability. In this preliminary analysis, the traffic and revenue impacts of tolling were calculated under both one-way and two-way toll collection, at two alternative toll levels.

The typical combination toll plaza would be as shown previously in Figure 2. Non-stop bypass lanes would be provided for both HOV traffic and pre-registered electronic toll vehicles. Only single occupant vehicles, and trucks, which were not participants in the AVI program would need to use the cash lanes. Hence, this combination program would significantly reduce the overall size of the toll plaza which might be otherwise required in the absence of ETC. At the same time, however, construction of attended toll lanes could result in some increase in congestion, possibly mitigating some of the benefits intended by the pricing program. If spot location pricing were implemented, careful planning of the toll facilities would be needed to ensure delays to users were not significantly increased as a result of tolling.

Estimated Traffic Impacts

Estimated traffic impacts for the I-494 (Wakota) and Wabasha Street Bridges are shown in Figure 4. All traffic impact estimates for this, and all of the scenarios, reflect 2015 levels. However, the overall 2015 computer model traffic assignments appear to be somewhat low in some areas, when related to existing ground counts. Hence, traffic and revenue estimates developed as part of this preliminary impact assessment may be considered somewhat conservative.

The existing Wabasha Street Bridge will likely carry slightly more than 26,000 vehicles per day in a toll-free condition. If a $0.50 passenger car toll were charged to non-HOV vehicles (proportionately higher rates for trucks), an estimated 6,300 vehicles per day would divert to alternative toll-free bridges. This represents about 30 percent of

* Tolled Bridge

SCENARIO Total Volume	TH 149	* ***WABASHA STREET***	ROBERTS STREET	TH 3
Toll Free	25,400	26,200	26,200	96,800
Two-Way $0.50	+1,000	-6,300	+2,000	+3,300
Two-Way $1.00	+1,500	-9,000	+3,000	+4,500
One-Way $1.00	+800	-4,500	+1,500	+2,200

SCENARIO Total Volume	70TH STREET	* ***I-494***	I-94	TH 36	I-694
Toll Free	16,500	93,000	112,000	56,500	70,000
Two-Way $0.50	+1,000	-3,500	+1,000	+500	0
Two-Way $1.00	+2,000	-8,300	+2,800	+1,200	0
One-Way $1.00	+1,000	-4,200	+1,400	+600	0

ESTIMATED DAILY TRAFFIC IMPACTS SPOT TOLLS ON WABASHA STREET BRIDGE AND WAKOTA / I-494 BRIDGE

2015 LEVELS

WILBUR SMITH ASSOCIATES

FIGURE 4

the non-HOV traffic which would otherwise be expected to use the Wabasha Street Bridge. If peak period tolls were increased to \$1.00, with off-peak tolls remaining at \$0.50, the total diversion to alternate bridges would increase to an estimated 9,000 vehicles per day, amounting to about 34 percent of total traffic and almost half of the toll-free non-HOV traffic.

The lower portion of Figure 4 shows estimated traffic impacts of hypothetically establishing tolls on the I-494 Bridge across the Mississippi River. This bridge was found to be much less sensitive to tolls, with a diversion of only about 3,500 daily vehicles from more than 93,000 vehicles assigned under a toll-free condition. While the traffic shift would increase at the \$1.00 peak period level, it still would be considerably less than 10 percent of the total traffic which would otherwise be expected to use the I-494 Bridge. This indicates that there are relatively few good alternatives to the I-494 Bridge. Note that only routes with relatively notable impacts are shown in Figure 4. There would also be small diversions to other local streets in the I-494 corridor, especially north of the bridge.

Traffic impacts for the two proposed new bridges, including the new Anoka and Stillwater Bridges are summarized in Table 1. In both cases, toll-free traffic estimates were taken from prior design and/or environmental studies. Diversion estimates were developed based on manual approximations.

In the case of the Anoka Bridge, about 10 percent of the traffic would be expected to divert to the competing TH 169 Bridge under the higher toll scenario. Again, it is important to recognize that even under the high toll scenario, off-peak tolls would be reduced to \$0.50. Potential traffic diversions were also heavily constrained by the capacity constraints on the competing TH 169 crossing.

An estimated 4,200 vehicles would divert back to the existing Myrtle Street Bridge from the proposed new Stillwater Bridge, if tolls were established at the \$1.00 level. If tolls were implemented in one direction only, traffic diversions are estimated at approximately half the levels of the two-way toll conditions. Note that Table 1 shows that all traffic diversions from the Stillwater Bridge would go the Myrtle Street Bridge; in practice some diversions might also go to the I-94 crossing.

Figure 5 shows estimated traffic shifts along the five-bridge screenline concept. This

Table 1

TRAFFIC IMPACTS
SPOT LOCATIONS - ANOKA & STILLWATER BRIDGES
2015 Levels

Proposed Anoka Bridge

SCENARIO	PASSENGER CAR TOLL RATE	AVERAGE DAILY TRAFFIC Proposed Anoka Bridge	TH 169 Bridge
Total Volume	Free	25,000	40,000
Traffic Impact:			
Two-Way	$0.50	(1,500)	1,500
Two-Way	$1.00 (1)	(2,500)	2,500
One-Way	$1.00 (1)	(1,300)	1,300

Proposed Stillwater Bridge

SCENARIO	PASSENGER CAR TOLL RATE	AVERAGE DAILY TRAFFIC Myrtle St. Bridge	Proposed Stilwater Bridge	I-94
Total Volume	Free	11,000	23,000	68,600
Traffic Impact:				
Two-Way	$0.50	2,800	(2,800)	0
Two-Way	$1.00 (1)	4,200	(4,200)	0
One-Way	$1.00 (1)	2,100	(2,100)	0

(1) With off-peak tolls discounted by 50 percent.

* Tolled Bridge

SCENARIO Total Volume	TH 21	*TH 41* *	*TH 169* *	*TH 18* *	*I-35W* *	*TH 77* *	I-494	TH 55	I-35E
Toll Free	2,200	20,000	27,600	63,900	105,500	98,100	78,900	47,000	72,300
Two-Way $0.50	+4,000	-2,000	-400	-2,400	-2,400	-6,200	+800	+8,000	+200
Two-Way $1.00	+5,600	-5,000	-800	-6,000	-5,300	-16,400	+5,600	+17,600	+3,400
One-Way $1.00	+2,800	-2,500	-400	-3,000	-2,600	-8,200	+2,800	+8,800	+1,700

ESTIMATED DAILY TRAFFIC IMPACTS
TOLLS ON BRIDGE SCREENLINE
2015 LEVELS

WILBUR SMITH ASSOCIATES

FIGURE 5

concept would establish tolls on all fixed crossings of the Minnesota River between Trunk Highway 41 on the west and Trunk Highway 77 on the east. As might be expected, the heaviest diversions would occur on the outermost crossings. Since all five bridges would be tolled at the same rates, the interior bridges, such as TH 169, TH 18 and I-35W would be expected to have less diversion since the nearest alternative toll-free route would be some distance away. The most significant increases in traffic would be expected on the Trunk Highway 55 and I-494 Bridges.

Transit/Ridesharing Impacts - Establishment of tolls on the various bridges tested in this scenario would be expected to have relatively small impacts on transit ridership, except where coincident increases in transit service could be anticipated in the immediate corridors. In a survey conducted at I-394 in February 1993, 22 percent of people driving alone said they might ride the bus at some time in the future if bus fares were reduced by half. However, less than 2 percent said they would "probably" or "definitely" ride the bus within the next six months. This would appear to have the highest level of potential in the southern corridor along the river screenline pricing concept. For example, the two-way $1.00 toll on I-35W is expected to shift approximately 1,400 persons to transit and the anticipated LRT facility in this corridor. This reduction would be divided between diversions to alternate routes, shifts to HOV/carpooling, and shifts to transit usage. At the isolated bridge locations, particularly those in the more outlying area such as Anoka and Stillwater, transit impacts would be considered negligible.

Since tolls would not be charged to HOVs, tolls may also give some increased incentive to carpooling. The survey conducted on I-394 in February 1993, indicated that 16 percent of people driving alone might carpool at some time in the future if their parking costs were only $15.00 per month. This represents a cost savings of about $75.00 per month per vehicle for downtown commuters. About 11 percent said they would "probably" or "definitely" carpool within the next six months. Again, the highest impacts would likely occur along the heavier commuter corridors, particularly in the south corridor in this hypothetical example where the Minnesota River Bridge screenline would be tolled. On I-35W, which is expected to have HOV lanes before 2015, 1,100 of the 5,300 vehicles per day reduction in traffic volume at the highest toll rate is estimated to be due to increased ridesharing. This represents a 7 percent increase in the projected level of ridesharing in this corridor. At those bridges where there were high opportunities for diversion to alternate toll-free routes, such as Stillwater and Wabasha Street Bridges, the potential for induced carpooling would be minimal.

Revenue Potential - Estimated annual toll revenue potential for the various spot location pricing concepts are summarized in Table 2. Estimates are shown individually for each of the bridges and collectively for the proposed Minnesota River screenline option. Revenue estimates were computed at theoretical 2015 demand levels, but using toll rates, values of travel time and other modeling inputs keyed to 1994 levels.

Capital and Operating Costs - Capital and operating costs for each of the bridges under the spot location toll concepts are shown in Table 3. These cost estimates relate only to the establishment and operation of toll collection facilities. They do not include capital costs associated with the bridge or approach road itself, nor do the annual costs include expenses for bridge maintenance, deck replacement, etc.

In developing estimates of capital and operating costs, it has been assumed that for spot location pricing projects a combination traditional/electronic toll collection system would be provided. The estimated capital cost for constructing and equipping toll plazas would range from about $2 million for each of the proposed new crossings to as much as $10 million to establish a toll plaza on the I-494 Bridge. The capital cost to construct the five toll plazas needed along the Minnesota River screenline option is estimated at about $28 million. Again, these costs are estimated in 1994-level prices.

For purposes of comparative analysis between options, the total estimated capital cost was "annualized," assuming a nominal 10-year life cycle. In practice, the toll plazas will last longer than 10 years, but significant renewal and electronic equipment replacement is likely during that period of time. For purposes of this analysis, financing costs have not been included for this or any of the various tolling scenarios examined as part of this study.

Annual operating costs are also shown in Table 3 for each bridge and for the Minnesota River screenline. At the smaller bridges, annual operating costs (in 1994 dollars) are estimated at about $400,000. This would be increased to about $2.0 million for the I-494 Bridge. For all five bridges of the Minnesota River screenline, the annual operating cost is estimated at $6,150,000.

When adding together the annualized capital cost of the toll plaza construction with the annual operating cost, the typical total annual cost of toll operations would range from about $600,000 at the smaller bridges to almost $9.0 million per year for the five bridges

Table 2

ESTIMATED ANNUAL REVENUE POTENTIAL
SPOT LOCATIONS
2015 Levels

SCENARIO/OPTION	PEAK PERIODS Daily Transactions	PEAK PERIODS Average Toll	PEAK PERIODS Daily Revenue	OFF PEAK PERIODS Daily Transactions	OFF PEAK PERIODS Average Toll	OFF PEAK PERIODS Daily Revenue	TOTAL DAY Daily Transactions	TOTAL DAY Daily Revenue	ANNUAL REVENUE (millions)
Rate 1 (1)									
Proposed Anoka Bridge	6,800	$0.530	$3,604	11,700	$0.530	$6,201	18,500	$9,805	$3.2
Proposed Stillwater Bridge	6,200	0.530	3,286	9,600	0.530	5,088	15,800	8,374	$2.7
Wabasha Street Bridge	6,200	0.530	3,286	8,500	0.530	4,505	14,700	7,791	$2.5
I-494/Wakota Bridge	31,500	0.530	16,695	40,900	0.530	21,677	72,400	38,372	$12.5
TH 41	4,200	0.530	2,226	7,800	0.530	4,134	12,000	6,360	$2.1
TH 169	8,000	0.530	4,240	14,600	0.530	7,738	22,600	11,978	3.9
TH 18	19,500	0.530	10,335	27,400	0.530	14,522	46,900	24,857	8.1
I35W	35,900	0.530	19,027	51,500	0.530	27,295	87,400	46,322	15.1
TH 77/Cedar Avenue	31,200	0.530	16,536	41,000	0.530	21,730	72,200	38,266	12.5
TOTAL SCREENLINE	98,800		$52,364	142,300		$75,419	241,100	$127,783	$41.7
Rate 2 (2)									
Proposed Anoka Bridge	5,800	$1.060	$6,148	11,700	$0.530	$6,201	17,500	$12,349	$4.0
Proposed Stillwater Bridge	4,800	1.060	5,088	9,600	0.530	5,088	14,400	10,176	$3.3
Wabasha Street Bridge	3,500	1.060	3,710	8,500	0.530	4,505	12,000	8,215	$2.7
I-494/Wakota Bridge	26,700	1.060	28,302	40,900	0.530	21,677	67,600	49,979	$16.3
TH 41	1,700	1.060	1,802	7,800	0.530	4,134	9,500	5,936	$1.9
TH 169	7,600	1.060	8,056	14,600	0.530	7,738	22,200	15,794	5.1
TH 18	15,900	1.060	16,854	27,400	0.530	14,522	43,300	31,376	10.2
I35W	32,400	1.060	34,344	51,500	0.530	27,295	83,900	61,639	20.1
TH 77/Cedar Avenue	21,000	1.060	22,260	41,000	0.530	21,730	62,000	43,990	14.3
TOTAL SCREENLINE	78,600		$83,316	142,300		$75,419	220,900	$158,735	$51.6
Rate 3 (3)									
Proposed Anoka Bridge	2,900	$1.060	$3,074	5,800	$0.530	$3,074	8,700	$6,148	$2.0
Proposed Stillwater Bridge	2,400	1.060	2,544	4,800	0.530	2,544	7,200	5,088	$1.7
Wabasha Street Bridge	1,760	1.060	1,866	4,300	0.530	2,279	6,060	4,145	$1.4
I-494/Wakota Bridge	13,500	1.060	14,310	20,400	0.530	10,812	33,900	25,122	$8.2
TH 41	600	1.060	636	3,900	0.530	2,067	4,500	2,703	$0.9
TH 169	3,800	1.060	4,028	7,300	0.530	3,869	11,100	7,897	2.6
TH 18	8,000	1.060	8,480	13,700	0.530	7,261	21,700	15,741	5.1
I35W	16,200	1.060	17,172	25,800	0.530	13,674	42,000	30,846	10.1
TH 77/Cedar Avenue	10,500	1.060	11,130	20,500	0.530	10,865	31,000	21,995	7.2
TOTAL SCREENLINE	39,100		$41,446	71,200		$37,736	110,300	$79,182	$25.9

(1) Peak period passenger car tolls are $0.50, off peak passenger car tolls are $0.50, two-directional toll.
(2) Peak period passenger car tolls are $1.00, off peak passenger car tolls are $0.50, two-directional toll.
(3) Peak period passenger car tolls are $1.00, off peak passenger car tolls are $0.50, one-directional toll.

Table 3

ESTIMATED CAPITAL AND OPERATING COST
Spot Locations
1994 Level Cost

BRIDGE	TOLL PLAZA(1) Total Cost	TOLL PLAZA(1) Annualized(2)	ANNUAL OPERATING COST	TOTAL ANNUAL COST(3)
	(--------thousands	--------	--------	--------)
New Stillwater Bridge	$ 2,000	$ 200	$ 400	$ 600
New Anoka Bridge	2,000	200	400	600
Wabasha Street Bridge	3,000	300	400	700
I-494 Wakota Bridge	10,000	1,000	2,000	3,000
Minnesota River Screenline				
TH 41	$ 2,000	$ 200	$ 400	$ 600
TH 169	2,000	200	500	700
TH 18	4,000	400	1,250	1,650
I-35W	10,000	1,000	2,000	3,000
TH 77	10,000	1,000	2,000	3,000
Screenline Total	$28,000	$2,800	$6,150	$8,950

NOTE: Above costs assume two-way toll collection on all bridges; costs for one-way collection would be approximately one-half those shown above.

(1) Includes plaza buildings, apron areas and toll/ETC equipment.

(2) Annualized plaza cost based on assumed life cycle of 10 years, including equipment.

(3) Annual cost related to toll collection only; does not include bridge maintenance, debt service or other costs not related to toll collection.

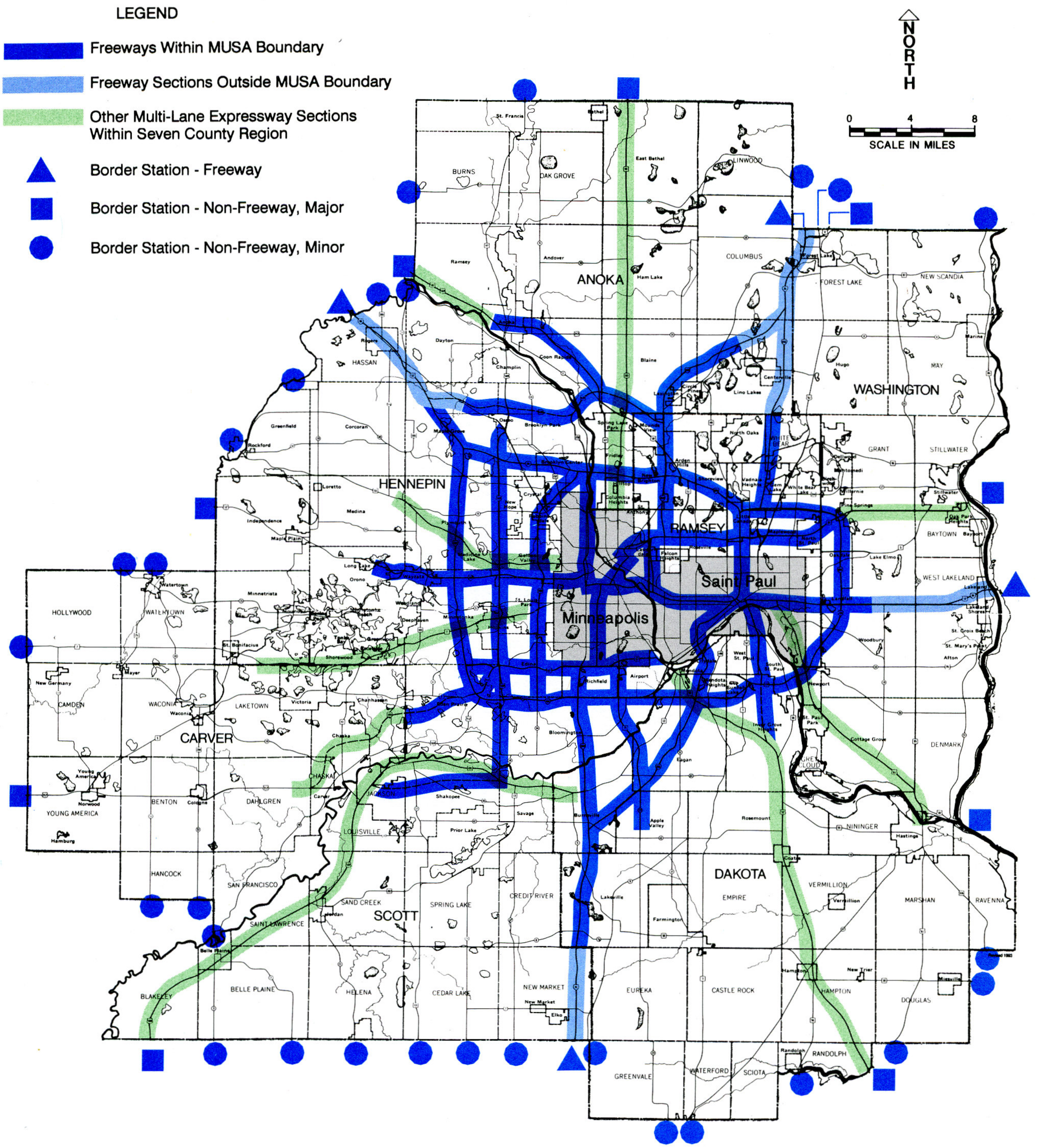
screenline across the Minnesota River. These are at 1994 level costs, and assume two-way toll collection. For those scenarios which would involve one-way toll collection, the total annualized cost would be about half of the values shown in Table 3.

A brief comparison of total annualized cost with estimated annual toll revenue is provided below for each of the hypothetical bridge crossings and the Minnesota River screenline. In all the bridge scenarios analyzed, the annual toll revenue is projected to be considerably higher than operating costs. It is noted, however, that toll revenue estimates are based on 2015 level traffic demands, although no inflation in toll rates has been assumed. It is recognized that net revenue potential was not necessarily the primary motivation in establishing road/congestion pricing on the various spot locations tested above. However, it is clear that the revenues generated under these potential demand management strategies would be greater than the cost of implementing and operating the revenue collection facilities themselves.

Full Limited Access Roadway Pricing

The second major category of pricing options evaluated as part of the study included the concept of placing tolls on some or all of the freeways and other limited access facilities in the seven-county Twin Cities region. As shown in Figure 6, three subcategories were identified. The first of these, depicted in darker blue, would involve application of congestion/road pricing on all freeways within the MUSA boundary. The second sub-option would extend the pricing to all freeways within the seven-county region, thereby adding the lighter blue corridors. Finally, the third option would add pricing to all other multi-lane expressway sections within the seven-county region such as U.S. Route 52, 169 and Trunk Highway 65, among others.

Under this innovative regional road pricing concept, all toll collection would be performed electronically. For purposes of this study, it has been hypothetically assumed that all vehicles registered within the seven-county area would be equipped with electronic transponders capable of being read at the various pricing locations throughout the region. Motorists with vehicles registered outside the seven-county region who regularly use Twin Cities area freeways would be able to also procure transponder devices. Finally, a series of border stations would be established around the perimeter of the seven-county region to make temporary transponders available for non-local traffic.



FULL FREEWAY SYSTEM PRICING

CONGESTION/ROAD PRICING STUDY

BASE MAP COURTESY OF METROPOLITAN COUNCIL

WILBUR SMITH ASSOCIATES

FIGURE 6

It is envisioned that the border stations would fall into three categories. Those at points where actual freeways cross the seven-county border would be constructed as typical combination electronic/manual toll plazas, as shown previously in the lower portion of Figure 2. Vehicles equipped with electronic transponders would simply pass through the toll plaza and be recorded as entering or exiting the freeway system. As with all of the pricing concepts, it was assumed that HOV and transit traffic would be allowed to use the freeway system toll-free; hence, HOV/transit bypass lanes would also be provided.

Only those vehicles not previously equipped with transponders would be required to stop. Using a cash deposit or some form of credit card arrangement, temporary transponders would be issued and placed on the vehicle windshield at the point of entering the seven-county region. As the transient vehicle exited the seven-county region, it would stop on the exiting toll lanes and surrender the temporary transponder, with the appropriate toll fare deducted and any balance remaining returned to the motorist.

Since it is possible that motorists may enter the seven-county region on roads other than freeways, but might then ultimately need to use the freeways while in the Twin Cities area, it would also be necessary to establish certain courtesy border stations along the side of other roadways. These are shown as squares or circles in Figure 6, delineating between major and minor routes. At the major stations, it is envisioned that, perhaps, two courtesy "toll" lanes would be provided in each travel direction while on the minor roads only a single turn-out would be provide on each side of the road to provide for issuance and retrieval of temporary transponders. Motorists passing the non-freeway stations which did not anticipate needing to use the freeway system would not be obligated to procure the temporary pass.

Actual revenue collection on the freeway (or expanded expressway) system would be based on distance traveled and time of day. It is envisioned that ETC interrogator devices would be established at all the freeway points of entry and exit of the seven-county region as well as intermediate ramps at all interchanges within the system. As the vehicle entered the freeway system, the point of entry would be recorded on the tag, the vehicle transponder and/or the vehicle computer-based account. As it exited the system, as shown in the middle section of Figure 2, which is shown previously following page 32, the vehicle would be again identified with the appropriate toll amount being calculated based on time of day and travel distance.

With a fully electronic toll collection system, it would be possible to vary toll rates based on time of day or other factors to better encourage implementation of regional policies setting increasing overall efficiency of the transportation system. For example, it would be possible to implement pricing only during peak hours or peak periods. It would also be possible to charge higher rates during peak travel periods, and only moderate rates during off-peak periods. One option would be to not assess any pricing during the late night hours, when traffic and congestion levels are particularly low.

Under this concept, it would also be theoretically possible to vary the per-mile pricing charge based on actual or routinely experienced congestion levels on particular roadway segments. For example, an overall road user charge of, say, $0.05 per mile might in effect during typical peak periods on most freeways. However, those freeways which experience highest levels of congestion might increase the per-mile rate to, say, $0.10 per mile as a disincentive for usage of those particularly congested facilities. All of this would be conducted electronically within the computer system and would be largely transparent to the user. Some form of advanced warning system of the pricing levels in effect would be needed at each of the entry ramps and at points of entry and exit from specially price congested areas.

If the pricing program were extended to other multi-lane expressway sections (e.g., those shown in green in Figure 6), it might be necessary to use overhead mounted antennas at various roadway segments. On those multi-lane expressways, there is not always full control of access, and it might not be practical to simply install interrogator devices at the points of exit and entry. The typical overhead antenna mounting would be similar to the example shown in the upper portion of Figure 2.

Estimated Traffic Impacts - The full freeway system pricing concept was tested at two alternative toll rate structures, each providing for off-peak period toll discounts. Under Rate Level 1, it was assumed that passenger car SOV's would be charged a per-mile rate of $0.05 during peak periods and $0.03 per mile during off-peak periods. Trucks would be charged proportionately higher rates. Under Rate Level 2, the peak period per-mile was assumed to be $0.10, while off-peak rates would be cut to $0.05 per mile. In both cases, minimum tolls would be assessed, for short trips. The minimum toll for any trip with a per-mile rate of $0.05 or less was assumed to be $0.25, while the minimum toll at the higher peak period rate was assumed to be $0.50.

The use of minimum tolls under the regionwide freeway congestion pricing scheme would be a deterrent to short trips using the freeway system. This is similar in concept to ramp metering which accomplishes the same objective by building in delay at the entry ramp location. By contrast, however, the pricing disincentive would have the advantage of eliminating traffic backups onto local streets that sometimes occurs during peak periods as a result of ramp metering.

The implementation of regional road pricing would not necessarily require the elimination of the ramp metering system. Ramp metering does have the advantage of breaking up "platoons" of vehicles entering congested areas. The scope and location of ramp metering might be able to be altered if a regionwide congestion/road pricing was implemented. This issue is something that should be subjected to more detailed analysis if further studies are conducted.

The imposition of tolls on the existing freeway system would be expected to divert some traffic away from the freeways and onto competing arterial streets. Tables 4 through 7 show estimated traffic impacts along four screenlines throughout the regional network. Two of the screenlines were oriented in a north-south direction while two were oriented in a east-west direction. For each screenline, the computer traffic assignment on each freeway link crossing the screenline under the base condition is shown. In addition, assigned traffic under each of the two toll rates is shown, along with the net impact associated with the change.

As can be seen in the tables, there would be a significant reduction in demand on the freeway links, particularly at the higher toll rate ($0.10 per mile in peak periods). A portion of the trips lost on the freeways would simply be diverted to alternative routes. However, there would also be expected to be a net decrease in the total traffic crossing each screenline.

The majority of the net trip reductions are a result of assumed shifts of some trips to carpools and a slight assumed overall dampening of demand. The scope and budget limitations of the study did not permit direct computation of inducements in ridesharing patterns or net trip reductions through the direct "modeling" process. Rather, reasonable approximations of carpool inducements and net trip reductions were made, and applied manually to the raw modeling output results. Based on estimates of total average trip costs, including vehicle operating costs and whatever toll charges might be imposed, and

Table 4

TRAFFIC VOLUMES ON SCREENLINE WEST OF ROUTE 100
Scenario: Toll All Freeways

	DAILY TRAFFIC				
		Toll Rate 1 (1)		Toll Rate 2 (2)	
TOLLED ROUTES	Base Case	Traffic	Net Impact	Traffic	Net Impact
U.S. Route 10	85,236	78,457	(6,779)	67,558	(17,678)
TH 610	23,271	20,436	(2,835)	16,774	(6,497)
I-94	92,527	79,328	(13,199)	63,149	(29,378)
I-394	121,924	110,109	(11,815)	91,868	(30,056)
Route 62	96,323	92,359	(3,964)	87,246	(9,077)
I-494	152,527	145,538	(6,989)	135,328	(17,199)
TOLLED ROUTES TOTAL	571,808	526,227	(45,581)	461,923	(109,885)
NON-TOLLED ROUTES	394,717	419,878	25,161	471,249	76,532
SCREENLINE TOTAL	966,525	946,105	(20,420)	933,172	(33,353)

NOTE: Traffic shown includes reductions for shifts to HOV and reduced tripmaking.
(1) Peak period toll of $0.05 per mile, offpeak toll of $0.03 per mile.
(2) Peak period toll of $0.10 per mile, offpeak toll of $0.05 per mile.

Table 5

TRAFFIC VOLUMES ON SCREENLINE BETWEEN I-35W AND I-35E
Scenario: Toll All Freeways

	DAILY TRAFFIC				
		Toll Rate 1 (1)		Toll Rate 2 (2)	
TOLLED ROUTES	Base Case	Traffic	Net Impact	Traffic	Net Impact
I-35W	37,047	34,265	(2,782)	28,751	(8,296)
I-694	96,020	87,142	(8,878)	72,703	(23,317)
TH 36	86,997	78,351	(8,646)	64,627	(22,370)
I-94	133,463	124,767	(8,696)	108,405	(25,058)
I-494	84,736	82,230	(2,506)	77,910	(6,826)
I-35E	71,945	67,520	(4,425)	60,779	(11,166)
TOLLED ROUTES TOTAL	510,208	474,275	(35,933)	413,175	(97,033)
NON-TOLLED ROUTES	318,006	337,465	19,459	388,084	70,078
SCREENLINE TOTAL	828,214	811,740	(16,474)	801,259	(26,955)

NOTE: Traffic shown includes reductions for shifts to HOV and reduced tripmaking.
(1) Peak period toll of $0.05 per mile, offpeak toll of $0.03 per mile.
(2) Peak period toll of $0.10 per mile, offpeak toll of $0.05 per mile.

Table 6

TRAFFIC VOLUMES ON SCREENLINE SOUTH OF I-694
Scenario: Toll All Freeways

		DAILY TRAFFIC			
		Toll Rate 1 (1)		Toll Rate 2 (2)	
TOLLED ROUTES	Base Case	Traffic	Net Impact	Traffic	Net Impact
I-494	55,096	48,725	(6,371)	40,533	(14,563)
US Route 169	69,685	64,980	(4,705)	57,448	(12,237)
Route 100	66,248	62,051	(4,197)	57,396	(8,852)
I-94	85,749	76,649	(9,100)	65,188	(20,561)
I-35W	98,430	86,263	(12,167)	70,755	(27,675)
I-35E	111,448	102,628	(8,820)	84,587	(26,861)
TH 36	24,876	23,446	(1,430)	21,730	(3,146)
I-694	39,075	34,217	(4,858)	27,046	(12,029)
TOLLED ROUTES TOTAL	550,607	498,959	(51,648)	424,683	(125,924)
NON-TOLLED ROUTES	349,768	380,709	30,941	439,009	89,241
SCREENLINE TOTAL	900,375	879,668	(20,707)	863,692	(36,683)

NOTE: Traffic shown includes reductions for shifts to HOV and reduced tripmaking.
(1) Peak period toll of $0.05 per mile, offpeak toll of $0.03 per mile.
(2) Peak period toll of $0.10 per mile, offpeak toll of $0.05 per mile.

Table 7

TRAFFIC VOLUMES ON SCREENLINE SOUTH OF I-394/I-94
Scenario: Toll All Freeways

	DAILY TRAFFIC				
		Toll Rate 1 (1)		Toll Rate 2 (2)	
TOLLED ROUTES	Base Case	Traffic	Net Impact	Traffic	Net Impact
I-494	65,635	63,327	(2,308)	59,303	(6,332)
TH 169	92,644	88,086	(4,558)	81,518	(11,126)
TH 100	115,916	109,912	(6,004)	101,752	(14,164)
I-35W	194,693	183,705	(10,988)	170,902	(23,791)
I-35E	84,220	80,895	(3,325)	75,126	(9,094)
TH 3	68,870	62,179	(6,691)	52,258	(16,612)
I-494	67,489	63,653	(3,836)	59,050	(8,439)
TOLLED ROUTES TOTAL	689,467	651,757	(37,710)	599,909	(89,558)
NON-TOLLED ROUTES	316,105	333,466	17,361	370,210	54,105
SCREENLINE TOTAL	1,005,572	985,223	(20,349)	970,119	(35,453)

NOTE: Traffic shown includes reductions for shifts to HOV and reduced tripmaking.
(1) Peak period toll of $0.05 per mile, offpeak toll of $0.03 per mile.
(2) Peak period toll of $0.10 per mile, offpeak toll of $0.05 per mile.

recognizing an approximate elasticity of -0.10, it was determined that tolls in the approximate amounts tested in this analysis would result in a trip dampening of about 3 percent at the highest toll rate. Obviously, this would be applied only to trips assigned to the limited-access facilities since only these would be assessed tolls.

It was further assumed that about 6 percent of the peak period vehicles would choose to shift to carpools. As noted previously, the analysis assumed that passenger vehicles with two or more occupants would not be subjected to toll charges; hence, there would be an increased direct incentive for ridesharing. The 6 percent value was actually based on an assumed 7 percent shift of passenger cars but was normalized to 6 percent since commercial vehicles were assumed to be present in the total trip tables within the model. This represents about 10 percent of the existing single-occupant passenger vehicles traveling on Twin Cities freeways. It also translates into a net traffic reduction of about 3 percent, since it was assumed that those single-occupant motorists choosing to carpool would simply switch to HOV-2 vehicles, to avoid toll payment.

Obviously, the total net reduction in regional travel is a very key parameter in determining the ultimate pricing levels and strategies to be implemented. In more detailed studies, this issue should be examined more closely, and it is recommended that the potential pricing applications be considered in the trip distribution and modal split phases of the modeling. The assumptions made as part of this study, however, are considered to be reasonable approximations given the preliminary nature of this evaluation.

For example, as shown in Table 4, which depicts an imaginary screenline west of Trunk Highway 100, imposition of tolls at $0.10 per mile on I-94 would result in a shift of over 76,000 vehicles per day to alternate routes, spread over a large number of alternates. At the lower toll level, estimated diversions of about 25,000 are shown. Principal important arterial routes would likely include Highways 7, 55, and 81, all of which would experience daily traffic impacts of about 10,000 vehicles or more at the high toll level in the year 2015. The base traffic estimate crossing this screenline is projected to be more than 966,000 vehicles per day.

Similar information is shown in Table 5 for another north-south screenline located between central Minneapolis and St. Paul. In this case, some 36,000 vehicles per day would be diverted off the tolled freeway routes at the lower toll rate. Slightly more than half of this would be shifted to alternative routes. The most heavily impacted of these would likely include U.S. Route 12/52, and County Route 23. On U.S. Route 12/52, the impact under the low toll rate would be less than 5,000 vehicles per day. However, at the higher toll rate of $0.10 per mile, the estimated impact would increase to more than 15,000 vehicles per day on U.S. 12/52. The total net reduction in trips along this screenline is estimated at almost 27,000 vehicles per day at the higher toll rate, representing about 3.2 percent of the total estimated screenline crossings at 2015 levels.

Table 6 shows an east-west screenline, located generally south of I-694. In this case, traffic on the freeway crossings would be reduced by almost 23 percent at the high toll rate, as compared with the toll-free condition. Of this, about two-thirds would result from diversions to alternative routes while about one-third would represent a net reduction in total trips across the screenline. A much lower impact is shown at the $0.05 toll rate. The traffic diversions would be spread over many routes, with the most notable impacts expected to occur on Highway 81 on the westside and U.S. Route 61 on the eastside.

Finally, Table 7 shows freeway traffic impacts on an east-west screenline located south of I-394/I-94, generally south of the Minneapolis and St. Paul central business districts. Freeway crossings along this screenline were found to be much less sensitive to tolls, based on the preliminary modeling effort done as part of this study. Even at the highest toll rate, the net total reduction in traffic away from the freeways amounted to less than 13 percent, with slightly more than half of this resulting from diversions to alternate routes and the remainder due to a net reduction in total trips. This net reduction amounted to about 3 percent of the screenline total, estimated at about 1.0 million trips per day under a toll-free condition in the year 2015. Again, traffic impacts on alternate routes would be spread over a wide variety of streets and highways; the most notable impacts were estimated in the vicinity of Trunk Highway 3 and included Smith Avenue, Robert Street and U.S. Route 61/10.

Overall, traffic on the freeway segments were found to be reduced by between 5 and 10 percent along the different screenlines at the lower toll rate, $0.05 per mile during peak periods. Traffic reductions on the freeways ranged from about 13 to 23 percent, depending on screenline, at the higher toll rate. The net traffic reductions across the screenlines ranged from about 2.0 to 4.1 percent, depending on toll rate and screenline.

As an approximate measure of impact on congestion, volume/capacity ratios for the p.m. peak period conditions are shown in Table 8. Information is shown for a limited

Table 8

COMPARISON OF VOLUME-TO-CAPACITY RATIOS
Base Scenario vs. Toll All Freeways Option

ROUTE	SEGMENT	DIRECTION	PM PEAK HOUR Base Case	Rate 1(1)	Rate 2(2)
I-494	South of I-94	SB	0.59	0.51	0.37
I-494	South of I-94	NB	1.13	1.04	0.88
TH 169	South of Excelsior Blvd.	SB	0.75	0.72	0.67
TH 169	South of Excelsior Blvd.	NB	0.83	0.81	0.71
TH 100	South of Excelsior Blvd.	SB	0.98	0.95	0.89
TH 100	South of Excelsior Blvd.	NB	0.90	0.87	0.78
I-35W	South of 42nd St.	SB	1.41	1.35	1.17
I-35W	South of 42nd St.	NB	1.27	1.21	1.06
I-494/5	East of 24th Ave.	WB	0.90	0.89	0.82
I-494/5	East of 24th Ave.	EB	1.01	1.00	0.93
I-35E	West of TH 77	SB	0.90	0.87	0.75
I-35E	West of TH 77	NB	0.75	0.68	0.57
TH 36	East of Lexington Ave.	WB	0.90	0.77	0.45
TH 36	East of Lexington Ave.	EB	1.22	1.10	0.90

(1) Peak period toll of \$0.05 per mile, offpeak toll of \$0.03 per mile.
(2) Peak period toll of \$0.10 per mile, offpeak toll of \$0.05 per mile.
(3) Assumes a.m. peak hour is 55 percent of a.m. peak period,
p.m. peak hour is 40 percent of p.m. peak period.

number of representative locations on the freeway system, both with and without tolls. As might be expected, as tolls are imposed and traffic on the freeway system is reduced, the level of service improves. The lower the volume/capacity ratio shown in Table 8, the better the average travel speeds and overall level of service.

Transit/Ridesharing Impacts - The regionwide freeway pricing system has the greatest potential for encouraging carpooling and/or transit utilization. By pricing virtually all limited access facilities, the overall level of toll charges would be greater and the number of acceptable alternative routes would be less. As a result, transit or carpool options would be more attractive.

This would be particularly true if revenue from the pricing system were funneled back into transit improvements and/or construction of commuter lots, HOV lanes, etc. As discussed previously, it was assumed that approximately 6 percent of SOV traffic would elect to shift to carpools in response to the highest toll levels tested. This would translate into a net reduction of 3 percent in vehicle trips. An additional reduction of 3 percent was assumed for modal shifts to transit and/or overall decreased tripmaking as a result of the toll charges. Assuming that half the reduction was due to modal shift and half due to reduced tripmaking, a total increase of approximately 10,000 transit riders could occur during the two peak periods if all freeways were tolled at the higher toll rate.

Other Considerations - On a systemwide basis, the broad application of road pricing on all freeways in the region could result in reductions in travel speed on arterial routings that could overshadow speed improvements on freeways, just as ramp meters sometimes cause gridlock on local streets and arterials. Under the concept analyzed in this study, those freeway segments that are not congested would be assessed the same toll as freeway segments that are highly congested. A more focused congestion pricing scheme would identify and toll only those segments that experience some level of congestion. This would serve to "equalize" travel speeds on all freeway segments and result in a more positive total impact on travel speeds on a network basis.

Revenue Potential - Implementation of electronic toll collection on the regionwide freeway system in the Twin Cities area would have enormous revenue potential. As shown in Table 9, revenue impacts were estimated assuming three alternative levels of regional tolling:

Table 9

ESTIMATED ANNUAL REVENUE POTENTIAL
TOLL FREEWAYS

SCENARIO/OPTION	PEAK PERIODS Daily Tolled VMT (millions)	PEAK PERIODS Average Toll(1)	PEAK PERIODS Daily Revenue	OFF PEAK PERIODS Daily Tolled VMT (millions)	OFF PEAK PERIODS Average Toll(1)	OFF PEAK PERIODS Daily Revenue	TOTAL DAY Daily Tolled VMT (millions)	TOTAL DAY Daily Revenue	ANNUAL REVENUE (millions)
RATE 1(2)									
Freeways Inside MUSA	7.10	$0.07	$497,000	10.71	$0.04	$428,400	17.81	$925,400	$301.7
All Freeways	7.50	$0.07	525,000	11.33	$0.04	453,200	18.83	978,200	318.9
All Freeways and Expressways	8.16	$0.07	571,200	12.37	$0.04	494,800	20.53	1,066,000	347.5
RATE 2 (3)									
Freeways Inside MUSA	5.22	$0.14	$730,800	9.61	$0.07	$672,700	14.83	$1,403,500	$457.5
All Freeways	5.49	$0.14	768,600	10.14	$0.07	709,800	15.63	1,478,400	482.0
All Freeways and Expressways	6.18	$0.14	865,200	11.07	$0.07	774,900	17.25	1,640,100	534.7

(1) Note that the average toll used in computing revenue is higher than the normal per-mile rates due to the impact of "minimum toll" provisions on shorter trips and the assumption that trucks would be assessed higher rates than passenger car tolls.
(2) Peak period passenger car tolls are $.05 per mile, off peak passenger car tolls are $0.03 per mile.
(3) Peak period passenger car tolls are $.10 per mile, off peak passenger car tolls are $0.05 per mile.

- On limited access freeways within the MUSA area;
- On all limited access freeways within the seven-county region; and
- On all freeways and other multi-lane expressways in the seven-county region.

Annual revenue at the lowest toll rates tested is estimated at between $302 and $348 million. This is considered to be an extremely conservative estimate, based on the apparently low growth rates assumed in the 2015 trip tables provided to WSA and the fact that no inflation is assumed in this analysis. The annual revenues are based on 2015 traffic levels, but 1994 level toll rates. If rates were increased due to inflation, actual revenues in 2015 would be considerably above those shown in Table 9.

Under the higher tolling structure, which includes a peak hour rate of $0.10 per mile and an off-peak rate of $0.05 per mile, annual revenues are estimated to range from about $458 million for just MUSA area freeways to as much as $535 million per year for the full freeway and expressway system.

In reviewing the estimates in Table 9, it is important to recognize that tolls would be collected only from non-HOV traffic. Some 20 percent of the 2015 trip table was assumed to be made up of vehicles with two occupants; hence these were removed from the trip table and assigned to the network separately without tolls.

The average tolls per-mile shown in Table 9 are somewhat higher than nominal per-mile rates actually used in the test assignments. This is due to the fact that tolls are also assumed to be charged to commercial vehicles, which would have higher per-mile rates. In addition, many of the trips are of a length which would fall within the "minimum toll" category. For these relatively short trips, the effective rate per mile is considerably higher than the nominal level. As a result, the effective average tolls per-mile are shown to be somewhat higher than the nominal rates tested.

Capital and Operating Costs - Table 10 presents a summary of estimated capital and operating costs associated with implementing and operating the regionwide freeway electronic pricing system. The upper portion of the table calculates the one-time initial capital cost for system implementation, all estimated at 1994 price levels. For example, under all three of the freeway pricing scenarios tested in this category, it is estimated that about $57 million would be required for construction of the various border toll stations around the seven-county region. Each of the interior interchanges on the freeway system

Table 10

ESTIMATED CAPITAL AND OPERATING COST
Full Freeway/Expressway System Options
1994 Level Cost

ITEM	SCENARIO: Freeways Within MUSA	Full Seven-County Freeways	Full Freeways and Expressways
	(thousands)		
CAPITAL COSTS			
Border Stations	$ 57,000	$ 57,000	$ 57,000
Interchanges	62,400	67,500	67,500
Mainline Tolling Zones	3,000	---	25,000
Central System	5,000	5,000	6,000
Communications	10,000	10,000	12,500
System Subtotal	$137,400	$139,500	$168,000
Transponders	60,000	60,000	60,000
TOTAL with Transponders	$197,400	$199,500	$228,000
ANNUALIZED CAPITAL COST			
System Cost (1)	$ 13,740	$ 13,950	$ 16,800
Transponders (2)	12,000	12,000	12,000
Subtotal	$ 25,740	$ 25,950	$ 28,800
ANNUAL OPERATING COST			
Border Plazas	$ 15,000	$ 15,000	$ 16,500
ETC System	14,000	15,000	19,000
System Maintenance	3,800	4,000	5,200
Miscellaneous	1,000	1,000	1,500
Subtotal	$ 33,800	$ 35,000	$ 42,200
TOTAL Annualized Cost	$ 59,540	$ 60,950	$ 71,000

(1) Annualized system cost based on a 10-Year Life Cycle.
(2) Annualized transponder cost based on a 5-Year Life Cycle.

would also need to be tolled, as shown previously in Figure 2. Assuming an overall average of six ramps per interchange regionwide, and an estimated total cost per interchange of $300,000 for ETC and AVC equipment, the tolling of the 208 internal interchanges on the freeway system within the MUSA area is estimated at $62.4 million. This would increase to $67.5 million if the area tolled is extended to the various county lines.

In some locations, mainline tolling zones would be required along freeway mainline segments. For example, under the option which would price freeways only within the MUSA area, it would be necessary to have a point of entry/exit tolling zone in addition to the internal interchanges. Were the full freeway system within the seven-county region tolled, no mainline tolling zones would be needed since the points of entry and exit into the seven county area would be equipped with border toll stations.

Where the expressway system were added into the tolling process, an additional $25 million is shown for "mainline tolling zones," since many of the expressways do not have fully controlled interchanges and the tolling on the expressway routes is assumed to be by means of periodic mainline tolling zone facilities. After adding in broad approximations of capital costs for central computer systems, software and a communications network, the total system cost is estimated to range from about $137 million to $168 million depending on the scenario.

Also inherent in the regionwide road pricing concept is the assumption that transponders would be provided for all registered vehicles within the seven-county region. There are currently more than 1.5 million passenger cars plus a large number of commercial vehicles in the region. Obviously this is expected to grow over time and for purposes of this analysis, it has been assumed that about two million transponders would need to be manufactured and distributed to regional motorists.

Since it is assumed a relatively sophisticated read-write type transponder would be needed, probably with a smart card interface, a unit cost of $30.00 per tag was assumed. Actual costs of intelligent read-write tags today are slightly higher than this level, but with improving technology and in the unprecedented quantity of two million, it is likely that the unit cost will be reduced to at least the levels shown in Table 10. Nonetheless, with two million vehicles in the region to be equipped, the cost for transponders would be a sizable $60 million.

If the local or regional governments absorb the full cost of the transponders as part of the expenses of program implementation, the total cost including plazas, system and transponders would generally be in the range of $200 million. Obviously, inclusion of expressways would add significantly to the cost, estimated at a total of $228 million. There is relatively little difference, however, between tolling freeways only within the MUSA area or the expanded full-county area. This is due to the fact that there are relatively few additional interchanges in the expanded freeway zone and by incorporating these within the system it would be possible to eliminate the need for any mainline tolling zone.

For purposes of comparative analysis, the system and transponder costs were annualized, assuming a life cycle of 10-years for the basic system costs and 5-years for transponder costs. This brings the total estimated annualized costs for system implementation to about $26 million per year for the freeway pricing options and almost $29 million per year if the other multi-lane routes are included.

Annual operating expenses were also estimated for each of the scenarios. By tolling the full freeway system within the seven counties, an annual operating cost of $35 million is estimated, including personnel for border station operations, expenses of the computerized ETC system data processing and billing, system maintenance and miscellaneous other costs. This still translates into a per-transaction cost systemwide of less than $0.05, based on more than 700 million annual transactions. This compares with revenue per transaction of about $0.45-$0.75 depending on toll rate.

When estimated operating costs are added to the annualized estimate of capital costs, the total annualized costs are shown to range from $59.5 million to $71.0 million depending on the size of the system. While these are certainly not insignificant costs, they are well below the revenue potential of this pricing system, as described previously in Table 9.

Individual Facility Concepts

As a variation on the full regional freeway system pricing concept discussed above, the study team also examined the hypothetical tolling of two single limited-access facilities within the region. As suggested by the Steering Committee, these two projects included one existing route and one proposed new limited-access facility. Selection of the projects were completely at random, and should not be an indication of any particular preference or recommendation regarding which facilities should be tolled.

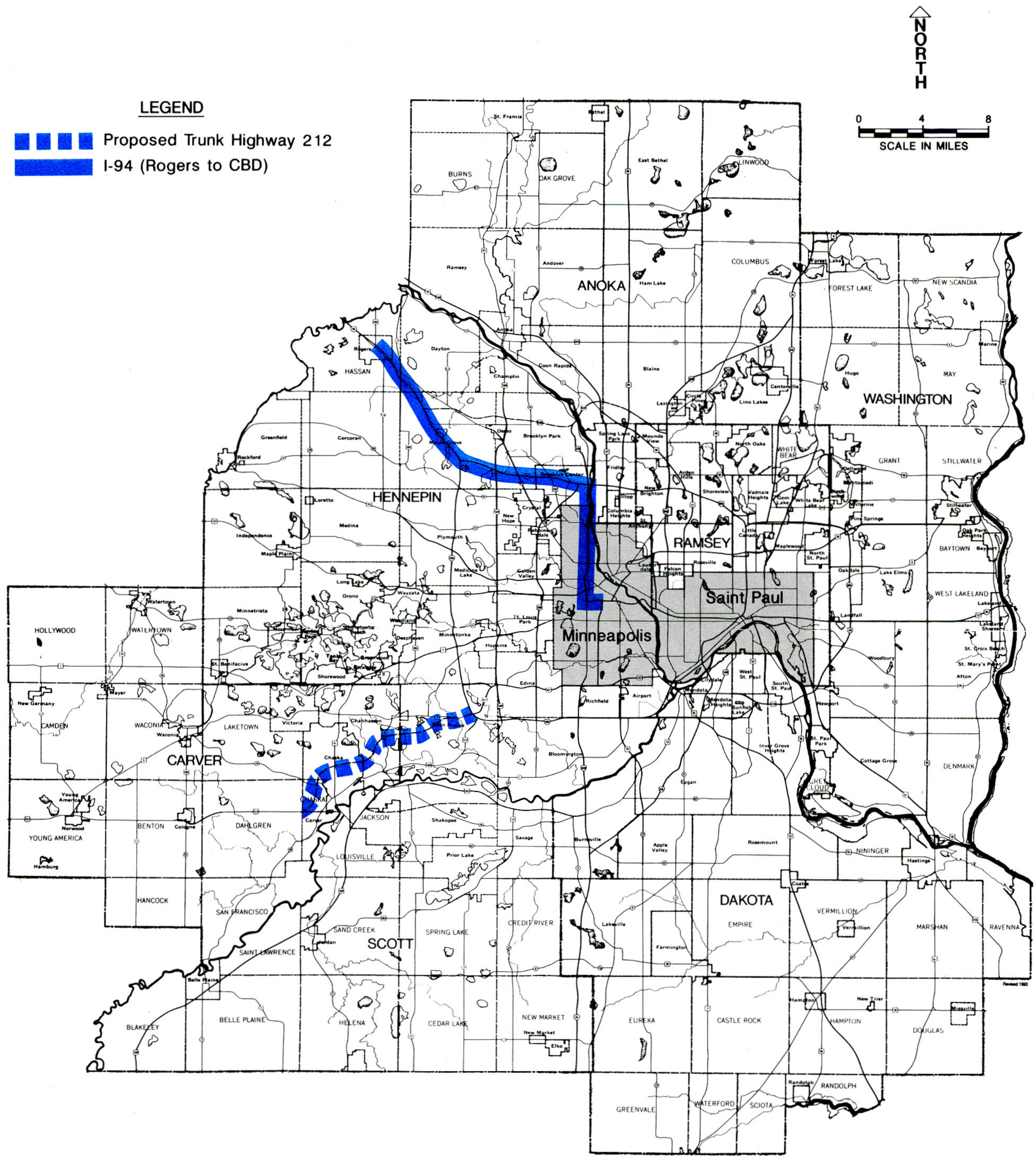
The existing corridor tested was I-94. As shown in Figure 7, the priced area would extend from Rogers in the northwest portion of the seven-county region to downtown Minneapolis. This would include a portion of the greater Minneapolis-St. Paul belt freeway system, as well as an immediate radial freeway segment directly feeding the downtown core area. In this scenario, I-94 was not assumed to be widened for HOV lanes.

The candidate new freeway which was selected for hypothetical toll evaluation was proposed Trunk Highway 212 in the southwestern portion of the region. As shown in Figure 7, this would extend from a junction with I-494 near Edina to a junction with existing TH 212 in Carver County. This limited-access facility has been planned for some time and environmental studies have been completed.

In both of these single facility concepts, it would be possible to use electronic toll collection. However, the study has found that the less broad the pricing application, in a regional context, the more likely it is that at least partial traditional toll collection techniques may also need to be offered. It would not be practical, for example, to equip all vehicles in the greater Twin Cities region with electronic transponders if the devices were to be used on only such a small portion of the total regional highway network.

Traffic and revenue impacts were estimated for each of these facilities as if fully electronic tolling were used. As a practical matter, it would be theoretically possible to add a limited number of cash collection locations along each of the routes, which would make the facilities available to all potential users.

In estimating capital and operating costs for implementing tolls on each of the facilities, a combination electronic/traditional system has been assumed. For purposes of simplicity and recognizing the preliminary nature of this study, however, anticipated toll revenue potential was computed on a per-mile tolling basis, as if fully electronic tolls were used. Any cash collection system would be structured to emulate, as closely as possible, rates which would be charged under an electronic tolling system. Even with the combination program, over a period of time it is likely that a majority of users would ultimately use ETC anyway.



SINGLE FACILITY PRICING

CONGESTION/ROAD PRICING STUDY

BASE MAP COURTESY OF
METROPOLITAN COUNCIL

WILBUR SMITH ASSOCIATES **FIGURE 7**

Estimated Traffic Impacts - The estimated traffic impacts of pricing individual freeways would generally be similar to those shown previously with respect to the full freeway pricing option, at least within the particular corridors affected. Overall, the traffic diversions under the individual project scenarios would be slightly less than those under the full system scenario, since the actual toll rates for many of the motorists would not be as high given that only part of the system were priced.

Transit/Ridesharing Impacts - Potential impacts on transit utilization and/or ridesharing would be similar under this concept to the full regionwide pricing program, at least with respect to the individual corridors tested. In the case of the I-94 hypothetical option, it would be a greater potential for increased transit utilization, since the corridor pricing option extended the full distance into the CBD. The analysis for this scenario did not recognize the proposed addition of HOV lanes on I-94. The TH 212 project would have a somewhat more limited potential benefit on transit utilization.

It is important to note, however, that under the individual pricing options one or more alternative freeway routings would theoretically be available as toll free alternatives. This differs from the full regional freeway congestion/road pricing program, under which transit and/or carpooling would likely appear to be a more attractive alternative, since there would not be alternative freeway routing which would be toll-free.

Revenue Potential - Annual toll revenue potential for individual project scenarios are shown in Table 11. Annual revenue potential was calculated as if fully electronic toll collection were implemented on each of the facilities. However, as noted above, it would probably be necessary to construct spot toll plazas to provide options for traditional toll collection, since the extent of regional tolling under this scenario would not be sufficient to justify equipping all two million vehicles for electronic tolls. The relative revenue estimates shown in Table 11 are reasonable approximations of revenue potential, however.

On the proposed Trunk Highway 212 project, annual revenue is estimated at between $6.0 and $10.5 million, depending on toll levels used. Again it is assumed that only non-HOV traffic is subjected to a toll. It is also assumed that significant off-peak toll discounts would be offered.

Considerably more revenue potential would exist if pricing were added to the existing I-94 corridor between Rogers and the Minneapolis CBD. Obviously, the length of this

Table 11

ESTIMATED ANNUAL REVENUE POTENTIAL
TOLL SINGLE FACILITIES-TH 212 AND I-94

SCENARIO/OPTION	PEAK PERIODS			OFF PEAK PERIODS			TOTAL DAY		
	Daily Tolled VMT (thousands)	Average Toll(1)	Daily Revenue	Daily Tolled VMT (thousands)	Average Toll(1)	Daily Revenue	Daily Tolled VMT (thousands)	Daily Revenue	ANNUAL REVENUE (millions)
TH 212									
Rate 1 (2)	133.4	$0.07	$9,336	227.1	$0.04	$9,082	360.4	$18,418	$6.0
Rate 2 (3)	123.2	0.14	17,251	212.9	0.07	14,901	336.1	32,152	10.5
I-94									
Rate 1 (2)	679.3	$0.07	$47,548	1,062.6	$0.03	$31,878	1,741.9	$79,426	$25.9
Rate 2 (3)	486.4	0.14	68,093	954.1	0.07	66,787	1,440.5	134,880	44.0

(1) Note that the average toll used in computing revenue is higher than the normal per-mile rates due to the impact of "minimum toll" provisions on shorter trips and the assumption that trucks would be assessed higher rates than passenger car tolls.
(2) Peak period passenger car tolls are $.05 per mile, off peak passenger car tolls are $0.03 per mile.
(3) Peak period passenger car tolls are $.10 per mile, off peak passenger car tolls are $0.05 per mile.

project is much longer than the TH 212 project and the existing and projected traffic levels are considerably higher. Annual revenue under this hypothetical pricing scenario is estimated at between $26 million and $44 million, depending on toll rate level.

Capital and Operating Costs - Table 12 presents a summary of estimated capital and operating costs for the single corridor options, including both I-94 and TH 212 projects. Up to three mainline toll plazas are assumed to be needed on I-94, each of which would provide an option for full non-stop electronic toll collection. The mainline toll plazas would likely cost in the range of $10 million. To ensure no toll-free travel, selected ramps along the affected segments are also assumed to be tolled, resulting in additional cost of $20 million for the I-94 scenario. In total, the capital cost of implementing tolls on I-94 is estimated at about $58.5 million. This results in a total annualized cost, including operating costs, of almost $11 million per year, at 1994 cost levels.

A considerably lower total annualized cost estimate is shown for TH 212. This project would likely require only one mainline toll plaza, given its relatively short length. A fewer number of ramp plazas are also needed, resulting in a total annual cost of about $2.5 million.

HOV/LRT Corridor Pricing

The fourth category of road pricing options would establish tolling in connection with existing and planned HOV and/or light rail transit (LRT) corridors. As shown in Figure 8, this would include I-94, I-394, TH 36, portions of I-494 and I-35W south of Minneapolis. It would also allow pricing the central freeway corridor along I-94 between the CBD of Minneapolis and St. Paul, where LRT service is proposed. LRT has also been proposed for the I-35W south corridor, in conjunction with HOV lane construction.

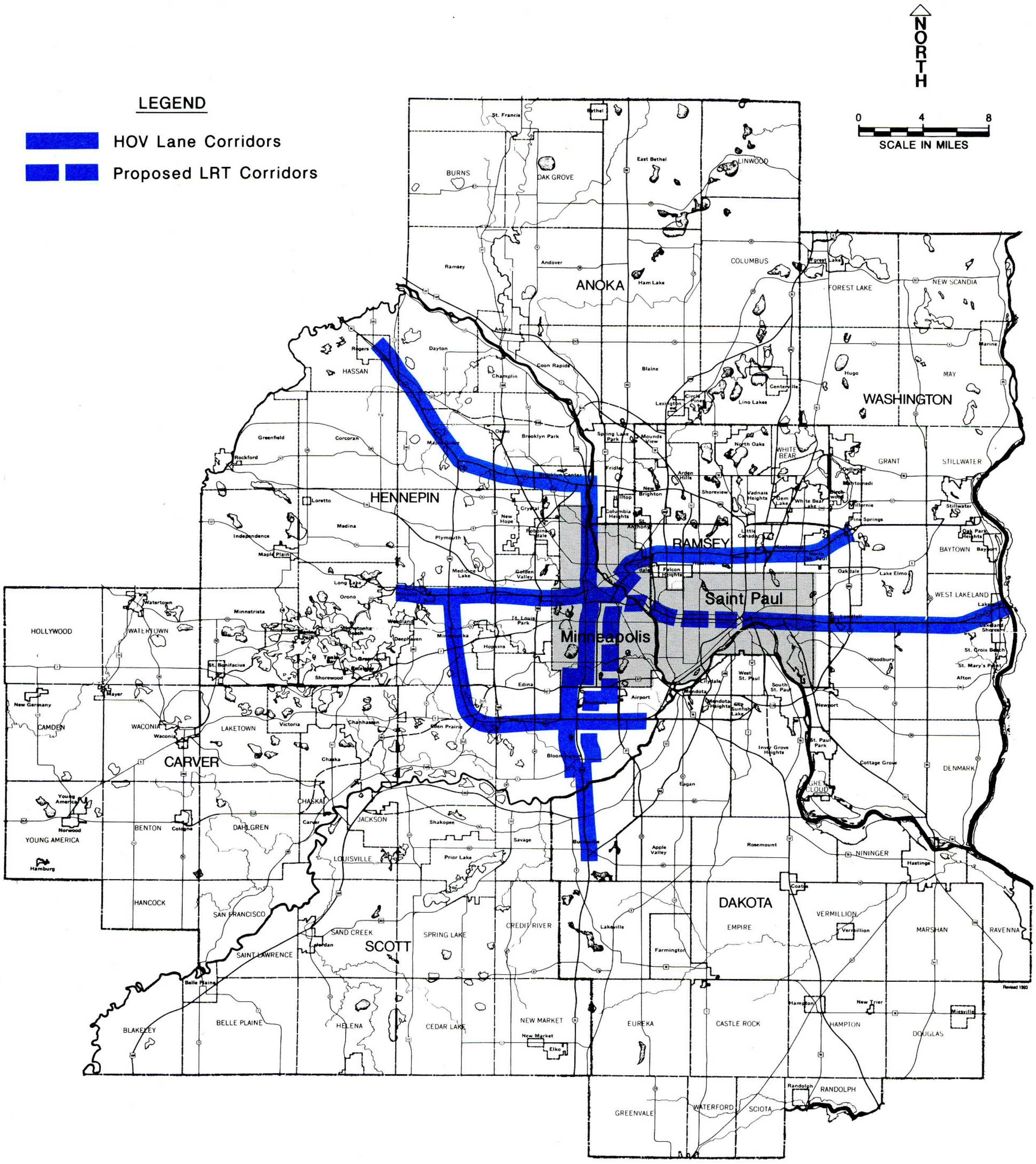
The "mixed-flow" lanes would be tolled, with all SOV and commercial vehicle traffic being charged while HOV traffic was toll-free. Obviously, the objective of this strategy would be to provide a further incentive for carpooling (or LRT usage) and a further disincentive to single occupant usage. It would also generate considerable revenue which could, in turn, be used to finance construction of additional HOV capacity, park and ride lots, LRT capital and operating costs, etc.

Table 12

ESTIMATED CAPITAL AND OPERATING COST
Single Corridor Options
1994 Level Cost

ITEM	I-94	TH 212
	(-----------thousands	------------)
Capital Costs		
Mainline Plazas	$ 30,000	$ 5,000
Ramp Plazas	20,000	8,000
Toll Equip/ETC System	8,500	2,500
Total Capital	$ 58,500	$ 15,500
Annualized Capital Cost(1)	$ 5,850	$ 1,550
Operating Cost	5,000	1,000
Total Annual Cost	$ 10,850	$ 2,550

(1) Annualized capital cost assumes 10-Year Life Cycle.



HOV/LRT CORRIDOR PRICING

CONGESTION/ROAD PRICING STUDY

BASE MAP COURTESY OF
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WILBUR SMITH ASSOCIATES

FIGURE 8

Logistically, this option would need to be implemented using fully electronic toll collection. It would appear logical to provide electronic toll collection devices to most vehicles in the region, although this is something that could be looked at in more detailed studies later.

Estimated Traffic Impacts - Estimated traffic impacts for the scenario in which SOV lanes would be priced would be expected to be quite similar to those which would be experienced under the full freeway tolling system, at least in the immediately priced corridors. HOV and transit vehicles could not be tolled. However, by implementing it in conjunction with the program of HOV lanes, the potential for increased carpooling would be greater, therefore the demand management benefit of pricing, in conjunction with the HOV facility, would be enhanced.

Implementation of a toll of $0.10 per mile on I-35W, with provision of HOV and LRT facilities, would result in an estimated reduction of 3,600 single-occupant vehicles during peak periods. Of these, approximately 1,400 persons would shift to LRT, and about 2,100 would shift to HOV.

Transit/Ridesharing Impacts - The concept of charging non-HOV traffic along the HOV/LRT corridors would, of course, have a significant impact on both ridesharing and transit utilization. Indeed, these were the primary motivation behind choosing this category of tolling options for evaluation in this study. Charging tolls for use of the congested SOV lanes would provide a direct identifiable additional disincentive to driving alone. If revenues generated from these vehicles were used to construct expanded HOV lanes as well as additional commuter lots, etc. that would further exacerbate the shift to carpooling and transit.

Similarly, in the LRT corridors pricing of the competing roadways would provide a direct further incentive for LRT utilization. If revenues generated from those corridor pricing applications were then used to support the construction or operation of the LRT, or other transit initiative corridors, the transit benefits would be enhanced.

This concept does raise an interesting question regarding construction of future HOV reserved capacity. Under the kinds of road pricing program examined in this study, it was assumed that high occupant vehicles would generally be exempted from tolling. Therefore, the pricing program provides some of the same incentives for carpooling as reserved capacity. This would probably only be a fully equivalent alternative to HOV lanes if the tolling levels charged to non-HOV traffic were sufficiently high to reduce congestion levels to the point where there was substantially free flow traffic conditions on the freeways (for both HOV and non-HOV traffic). This might make reserved capacity for HOV's somewhat superfluous. Obviously, the difference would be that the non-HOV traffic would be paying the full cost of maintaining the free flow conditions. This is clearly another area which should be evaluated in more detail if decisions are made to further explore road pricing in the Twin Cities area.

Revenue Potential - Revenue potential was estimated under two alternative assumed conditions. In the first case, tolls would be charged only during peak periods, and only in the peak travel direction. This is due to the fact that most of the HOV network utilizes concurrent lanes, which are reserved for HOV traffic only during certain hours of the day; the "diamond" lane concept. Obviously, pricing during off-peak hours, or in the minor direction, when the designated lane was not restricted to HOV's might not be necessary. Due to the limited number of hours of operation, this scenario would produce an estimated annual revenue of only about $26 million. As an alternative, revenue potential is calculated assuming pricing was implemented on a full-time basis, with differential levels between peak and off-peak periods, and assessed in both travel directions. This would be essentially the same as the full freeway system option, except that the pricing would apply only to those segments of the freeway system which would have designated HOV lanes and/or LRT corridors. Under this option, annual revenue potential would be increased significantly, to an estimated $185 million per year.

Capital and Operating Costs - Table 13 shows estimated capital and operating costs for the scenario in which SOV pricing would be applied only in the HOV/LRT corridors. The total annualized cost is estimated at almost $42 million. This is due to the fact that even though a smaller portion of the freeway system would be priced, it would probably be sufficiently large to warrant issuance of transponders to all two million vehicles in the seven-county region. It would also be necessary to construct and operate the various border stations, although possibly to a slightly lower standard at the actual freeway entrance points. Hence, the estimated capital costs for border stations was reduced to $50 million.

"HOV Buy-In" Concept - An important variation on the scenarios tested in this study would be the "HOV Buy-In" concept. All traffic, revenue and cost estimates discussed

Table 13

ESTIMATED CAPITAL AND OPERATING COST
SOV Pricing in HOV/LRT Corridors
1994 Level Cost

ITEM	ESTIMATED TOTAL COST	ANNUALIZED CAPITAL COST(1)
	(----------------thousands	----------------)
CAPITAL COSTS		
Border Stations	$50,000	$ 5,000
Interchanges	35,400	3,540
Mainline Tolling Zones	3,500	350
Central System	4,000	400
Communications	6,000	600
System Subtotal	$ 98,900	$ 9,890
Transponders (2 Million)	60,000	12,000
Subtotal	$158,900	$ 21,890
ANNUAL OPERATING COSTS		
Border Plaza Operations		$16,500
ETC System Operations		1,000 (2)
System Maintenance		2,000
Miscellaneous		500
		$ 20,000
TOTAL Annual Cost		$ 41,890

(1) Annualized cost assumes 10-year life cycle for capital costs except transponders, when a 5-year life cycle was used.
(2) Value shown is for peak period/peak direction only. If all day tolls were implemented, cost for this item would be $5,000,000.

above assume tolls would be applied to the non-HOV traffic required to use the "mixed-flow" lanes. There would be no tolls assessed in the HOV lanes themselves.

A concept which has received considerable attention recently is the idea of allowing single-occupant vehicles to use HOV lanes for a certain toll. In this case, tolls would only be applied to non-HOV traffic which wanted to realize the potential time savings advantages of HOV lane usage. In essence, the price paid would be in lieu of the decision to carpool.

While the concept is considerably different from the basic ideas studied above, it does have merit, particularly where existing HOV capacity has not yet been constructed, such as the project under construction in Orange County, California, along S.R. 91. In this case, four additional "toll" lanes are being constructed in the median of an existing congested freeway. Vehicles with three or more occupants will be permitted to use the "toll" lanes for free. All other vehicles, including SOV and vehicles with two occupants, will be required to pay tolls. Revenues generated by those choosing to avoid congestion by paying tolls will be used to amortize the cost of constructing the HOV lanes. The concept may even have some merit with respect to existing HOV lanes, which are often underutilized. By allowing the pricing option for SOV use, revenues could be generated which could, in turn, be used to further foster ridesharing and/or transit alternatives. By allowing some SOV usage of the HOV lanes, but ensuring free-flow condition for bona fide high-occupant vehicles through congestion pricing of SOVs, a more efficient utilization of the overall available roadway capacity would be provided.

Supporters of the concept also argue that tolled use of HOV lanes by SOV traffic would also put a more direct, easily recognized "price tag" on the cost of driving alone. It would provide a more readily evident "trade off" for motorists. The HOV "Buy-In" idea would probably have a relatively high level of public acceptability, as compared to some other congestion/road pricing options, since only those motorists receiving the premium level of service would be required to pay.

To date, FHWA has been largely unreceptive to the HOV "Buy-In" concept. Several proposals of this nature were submitted under terms of the Congestion Pricing Demonstration Project with ISTEA. There is at least some feeling that the idea may act as a disincentive to carpooling, by providing a priced alternative as a means of using the free-flowing reserved capacity. In recent months, however, there has been some indication that the federal position on the idea may be reconsidered, but at the time of this report, no specific changes could be confirmed.

Eventually, consideration was given to evaluate an HOV "Buy-In" option as part of this study. However, in most cases, HOV capacity is provided in the Twin Cities area by using the "diamond lane" concept. In this case, lanes are reserved for high-occupant vehicles only during certain times of the day, and there is no physical separation between the mixed-flow and HOV lanes. The only means of identifying high-occupant vehicles is through visual observation.

Without some type of physical separation between the mixed-flow and HOV lanes, implementation of the SOV pricing option would be extremely difficult. Without a physical barrier, vehicles are able to move into and out of the HOV lanes at an unlimited number of locations along the corridor. It would be most difficult to identify SOV violators in the HOV lanes from the toll paying, AVI-equipped SOV vehicles; hence, it would be almost impossible to enforce the occupancy restrictions under the diamond lane buy-in concept.

The enforcement problems with the HOV "Buy-In" options differ from those of a scenario in which the mixed-flow lanes would be tolled. Enforcement in the latter case would simply be to identify vehicles not properly equipped with valid ETC transponders, since all vehicles not eligible to use HOV lanes would be required to be so equipped. The enforcement problem under the HOV "Buy-In" concept relates more to violations of HOV restrictions and not only revenue collection.

As such, this concept was not given further evaluation as part of this preliminary study. However, it is an idea which may have merit in those areas where future HOV lanes may be constructed with some measure of physical separation from the mixed-flow lanes, such as a portion of the I-394 reversible HOV lane segment. If future HOV capacity is considered using this approach, it would be possible to also consider use of the HOV "Buy-In" concept. This could be addressed in more detailed studies in the future, if desired.

MUSA Area Pricing

The final set of road pricing options tested as part of this study involved the establishment of entry tolls at the limits of the Metropolitan Urban Service Area, or MUSA line. Figure 9 shows the approximate MUSA boundary. The boundaries shown in Figure 9 reflect a fairly simplistic interpretation of the actual, more detailed MUSA line, which includes various indentations and "islands." However, it would probably not be practical to precisely follow the MUSA line since this might result in single roadways running in and out of the protected area.

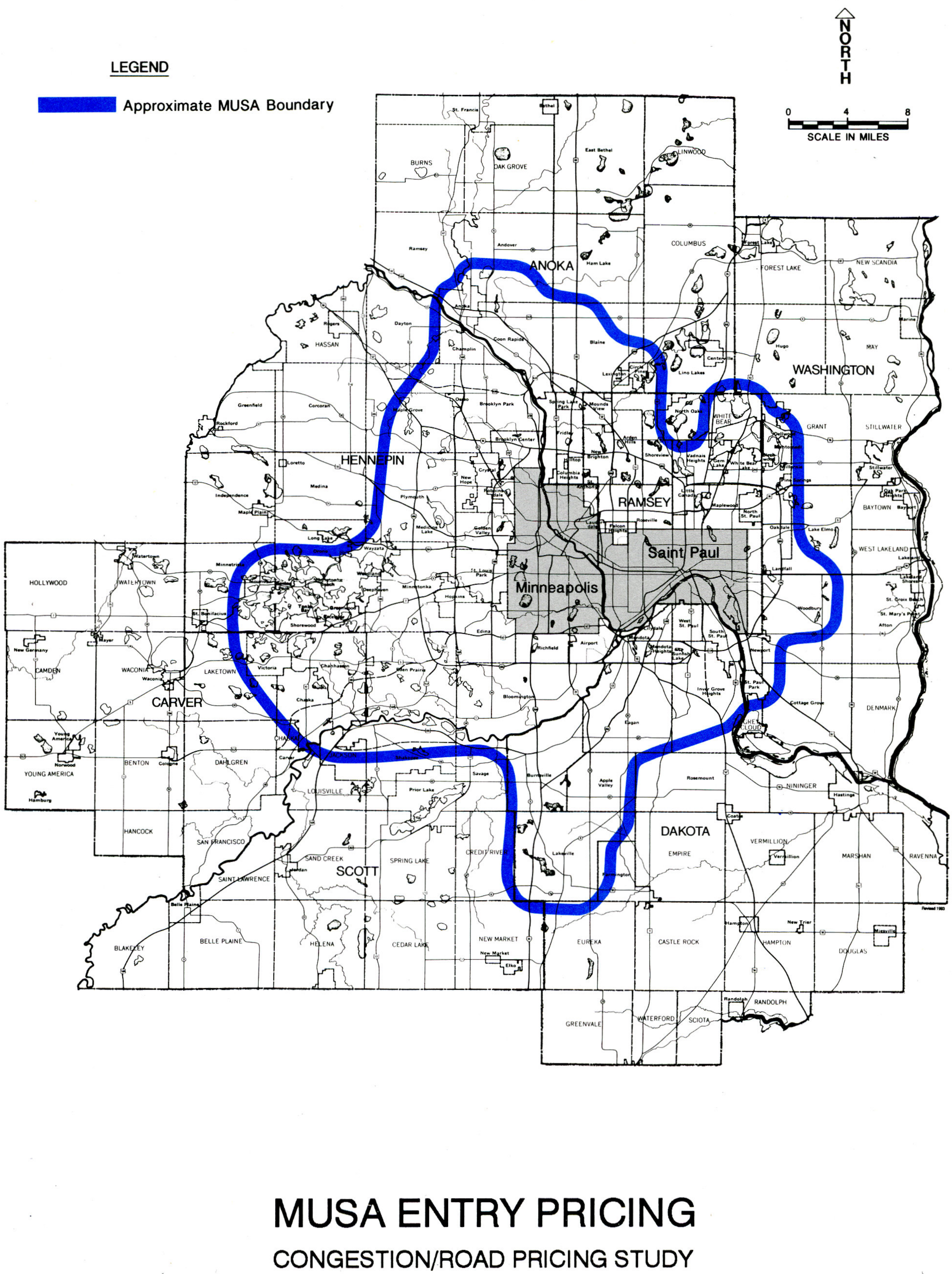
Under this basic idea, MUSA border tolling stations would be established on all roads, including non-limited access routes, entering the area. Per instruction of the Project Management Team, this scenario assumed that vehicles registered inside the defined MUSA area would be exempt from tolling, and would probably receive windshield stickers. Vehicles registered outside the MUSA area would be required to pay a toll when entering the area at the time of crossing the MUSA line.

For purposes of this analysis, it was assumed that there would be an option available to motorists with vehicles registered outside the MUSA to purchase some type of "annual pass" which would entitle the vehicle to unlimited crossings during a given year for a predetermined annual amount.

Vehicles without the annual pass or exempt stickers would be required to pay a cash toll for each entry trip into the area. Three levels of toll charges were tested; $0.50, $1.00 and $1.50 for passenger cars. In these cases, the cost of a typical annual pass was assumed to be $50, $100 or $150, respectively. This would be the equivalent of about 100 round trips per year.

Tolls would be accessed only in the entry direction at each location. There would be no charge to leave the MUSA area. At larger roads, attended toll collection facilities would be constructed at the entry points, although bypass lanes would be provided for vehicles with exempt or annual pass stickers. It is anticipated that a majority of traffic crossing the MUSA boundary would be able to use these bypass lanes and only a small proportion would actually be required to pay cash tolls.

At more lightly travelled routes, such as local roads crossing the boundary, it would be possible to use automatic coin machines in an unattended mode for revenue collection. It would not appear to be necessary to use electronic toll collection under this option, since only a small proportion of the total regional vehicle population would actually be



MUSA ENTRY PRICING

CONGESTION/ROAD PRICING STUDY

BASE MAP COURTESY OF
METROPOLITAN COUNCIL

WILBUR SMITH ASSOCIATES

FIGURE 9

required to pay a toll. Recognizing that annual stickers would be made available for out of area vehicles, it is likely that most motorists who might be inclined to use electronic toll collection would instead opt for the discounted annual pass. Therefore, the only remaining population which would be required to pay cash tolls would be relatively infrequent users, including out-of-state vehicles. These would not be potential users of electronic tolls, in any case.

Estimated Traffic Impacts - Traffic impacts associated with the MUSA line entry line toll concept would be expected to be relatively minimal. Since all routes entering the MUSA would be tolled, there would not be an opportunity for redistribution of traffic between routes. Further, the actual toll charges would likely be assessed to less than half of the total vehicles entering the region, since neither HOV traffic or any type of vehicle registered within the MUSA area would be subjected to tolls. Overall, there would probably be a slight reduction in the number of vehicles actually crossing the MUSA line. This would be typically limited to a reorientation of trips to stay outside of the MUSA area. This is estimated to amounts to only a few percent of trips crossing the MUSA line which, in turn, amounts to a very small portion of total regional trips.

Transit/Ridesharing Impacts - Obviously, the rationale for the MUSA entry pricing scheme is somewhat different than the other options evaluated. It would not be as much a means of reducing congestion as it would be a means of encouraging future development patterns in a manner consistent with current regional development goals. That is, it would encourage more of the future development to occur within the primary urban service area, where transit options and other non-SOV alternatives would likely be available.

Revenue Potential - Revenue potential of the MUSA entry toll pricing concept is shown in Table 14. Three hypothetical entry toll levels were tested, ranging from $0.50 to $1.50 per entry for passenger vehicles. As noted previously, it was assumed that MUSA registered vehicles would not be required to pay a toll. It was also assumed that an annual pass would be made available for relatively frequent users which would have an effective rate per trip of about one-half the cash toll. For purposes of analysis, it was assumed that 50 percent of the vehicles crossing the MUSA line would be registered within the MUSA. Another 25 percent of the vehicles would opt for the annual pass, while less than one-fourth would actually be required to pay cash tolls after excluding HOV's. Annual revenue under the $0.50 entry toll is estimated at less than $16 million

Table 14

ESTIMATED ANNUAL REVENUE POTENTIAL
MUSA LINE ENTRY TOLLS

	PEAK PERIODS			OFF PEAK PERIODS			TOTAL DAY		
SCENARIO/OPTION	Daily Transactions	Average Toll	Daily Revenue	Daily Transactions	Average Toll	Daily Revenue	Daily Transactions	Daily Revenue	ANNUAL REVENUE (millions)
Rate 1 (1)									
MUSA Registered Vehicles	63,320	$0.000	$0	90,860	$0.000	$0	154,180	$0	
Annual Pass Vehicles	31,660	0.265	8,390	45,430	0.265	12,039	77,090	20,429	
Other Traffic								0	
-Cash (2)	17,612	0.530	9,334	34,530	0.530	18,301	52,142	27,635	
-HOV	6,330	0.000	0	9,090	0.000	0	15,420	0	
TOTAL	118,922		$17,724	179,910		$30,340	298,832	$48,064	$15.7
Rate 2 (3)									
MUSA Registered Vehicles	63,320	$0.000	$0	90,860	$0.000	$0	154,180	$0	
Annual Pass Vehicles	31,660	0.530	16,780	45,430	0.265	12,039	77,090	28,819	
Other Traffic								0	
-Cash (2)	16,690	1.060	17,691	32,710	0.530	17,336	49,400	35,027	
-HOV	6,330	0.000	0	9,090	0.000	0	15,420	0	
TOTAL	118,000		$34,471	178,090		$29,375	296,090	$63,846	$20.8
Rate 3 (4)									
MUSA Registered Vehicles	63,320	$0.000	$0	90,860	$0.000	$0	154,180	$0	
Annual Pass Vehicles	31,660	0.795	25,170	45,430	0.398	18,081	77,090	43,251	
Other Traffic								0	
-Cash (2)	15,760	1.590	25,058	30,890	0.795	24,558	46,650	49,616	
-HOV	6,330	0.000	0	9,090	0.000	0	15,420	0	
TOTAL	117,070		$50,228	176,270		$42,639	293,340	$92,867	$30.3

(1) Peak period passenger car tolls are $0.50, off peak passenger car tolls are $0.50.
(2) Revenues for cash component have been adjusted to account for toll evasion of 50 percent at unattended locations, and 10 percent at other entry points.
(3) Peak period passenger car tolls are $1.00, off peak passenger car tolls are $0.50.
(4) Peak period passenger car tolls are $1.50, off peak passenger car tolls are $0.75.

per year. If the rate was increased to $1.50 per entry, tolls are projected to reach $30 million.

Capital and Operating Costs - It is anticipated that the traditional toll collection techniques would be used for collecting revenues from vehicles entering the MUSA area. At the larger roads crossing the MUSA line, this would require construction of small toll plazas, in one direction only. At the lightly utilized roadways, a single automatic coin machine with a small turnout lane would be sufficient. Obviously, use of unattended toll collection would result in significant levels of toll evasion; the annual revenue estimates have been adjusted to reflect this. As shown in Table 15, the total annualized cost is estimated at $18.7 million.

Summary of Revenue/Cost Relationships

Table 16 provides a useful comparative summary of the relationship between revenue potential and annualized cost of each of the various alternative options for congestion pricing in the Twin Cities area. Again, it is emphasized that the routes selected for this analysis were purely hypothetical and intended to be illustrative of typical pricing strategies to determine relative revenue, cost and traffic impact implications. The study did not reach any conclusions regarding optimum routes for tolling or an optimum pricing strategy for the region.

Where multiple toll rates were tested, revenue/cost ratios are provided for both scenarios. Where more than two alternative toll rates were tested, the table shows the lowest and highest rates. For purposes of a relative comparison between options, the overall financial feasibility of each option was determined by simply dividing annual revenue potential, at 2015 demand levels (but using 1994 prices) by the estimated average annualized cost (also at 1994 levels.) As noted previously, for each scenario the annualized cost includes estimated annual operating expenses as well as an annualized estimate of the cost of implementation, normally assuming a 10-year life cycle.

The revenue/cost ratio is determined by simply dividing annual revenue potential by total estimated annualized cost. Obviously, the higher the revenue/cost ratio, the greater the net revenue potential of a particular scenario, and the greater the overall financial feasibility. As might be expected, the highest revenue/cost ratios are shown for the full freeway system pricing options. For example, if pricing was established on all freeways

Table 15

ESTIMATED CAPITAL AND OPERATING COST
MUSA Line Entry Tolls
1994 Level Cost

ITEM	LARGE PLAZAS(1)	MEDIUM PLAZAS(2)	SMALL PLAZAS(3)	TOTAL
Number in System	15	18	56	89
Estimated Capital Cost (000)	$ 24,000	$ 13,500	$ 8,400	$ 45,900
Annualized Capital Cost (000)	2,400	1,350	840	4,590
Operating Cost	9,000	4,500	560	14,060
TOTAL Annualized Cost	$ 11,400	$ 5,850	$ 1,400	$ 18,650

(1) Large plazas assumed to have four toll lanes; two attended.
(2) Medium plazas assumed to have two toll lanes; one attended.
(3) Small plazas assumed to be single lane, unattended sites.

Table 16
REVENUE/COST SUMMARY

SCENARIO	TOTAL ANNUAL COST (000)	LOW TOLL RATES Annual Revenue (000)	LOW TOLL RATES Rev/Cost Ratio	HIGH TOLL RATES Annual Revenue (000)	HIGH TOLL RATES Rev/Cost Ratio
Spot Locations (1)					
New Anoka Bridge	$600	$3,200	5.33	$4,000	6.67
New Stillwater Bridge	600	2,700	4.50	3,300	5.50
Wabasha St. Bridge	700	2,500	3.57	2,700	3.86
I-494/Wakota Bridge	3,000	12,500	4.17	16,300	5.43
Minn. River Bridge Screenline	8,950	41,700	4.66	51,600	5.77
Full Freeway System					
MUSA Area Only	59,540	301,700	5.07	457,500	7.68
Full 7-County Area	60,950	318,900	5.23	482,000	7.91
Full Area with Expressways	71,000	347,500	4.89	534,700	7.53
Single Corridor Options					
I-94	10,850	25,900	2.39	44,000	4.06
TH 212	2,550	6,000	2.35	10,500	4.12
HOV/LRT Corridors (Tolling SOV Lanes)					
Peak Period/Major Dir. Only	41,890	--	--	26,000	0.62
Full Time Tolling	45,890	--	--	185,000	4.03
MUSA Line Entry Tolls (2)	18,650	15,700	0.84	30,300	1.62

(1) All bridge scenarios assume 2-way toll collection.
(2) Includes a reduction of 50 percent in the cash-paying component at unattended entry locations, and 10 percent at attended locations to account for toll evasion.

within the seven-county area, at the higher toll rate of $0.10 per mile during peak hours with a 50 percent discount during off-peak hours, annual toll revenue would be 7.91 times the annual cost of operation. Expressed differently, after deducting an estimated total annualized operating cost of about $61 million, the seven-county freeway pricing system would still generate net revenues of $421 million per year.

Limiting the system to only MUSA area freeways slightly reduces the revenue/cost ratio, although it is still very positive. Adding in the various expressway sections would slightly increase overall net revenue but would reduce the net ratio of revenue to cost.

The annual revenue potential of placing tolls on any of the bridges shown would exceed the actual cost of collection, including toll plaza construction, by a considerable margin. For example, putting tolls on the Minnesota River Bridge screenline would produce $52 million in annual revenue, as compared with less than $9 million in annualized costs. Annual revenue potential from placing tolls on the I-494 Bridge would be 5.4 times greater than the total annualized cost of establishing toll collection. Obviously, these relative feasibility measures only relate revenue potential to the cost of collecting net revenue; this does not suggest that the net revenue potential would necessarily be sufficient to finance the actual construction cost of a new bridge itself.

Only two of the many scenarios tested were found to have revenue/cost ratios of less than one (i.e., the estimated operating cost would exceed revenue potential.) Under the lowest toll rate, the MUSA line entry tolls would produce less revenue than cost, largely due to the need for extensive manual collection facilities at a number of locations. Similarly, pricing only those freeway segments adjacent to HOV or LRT corridors, during only peak periods in the major travel direction would also produce revenue which is less than the annualized cost. This is due to the fact that it has been assumed that all vehicles in the region would need to be equipped with electronic transponders, and order toll stations would need to be established in support of a relatively limited tolling application. However, if the HOV/LRT corridor option were extended to full time tolling, even for the reduced number of freeway segments, annual revenue potential would significantly exceed the annualized cost by more than 4 times.

Comparative Impact Analysis

The various hypothetical congestion/road pricing scenarios evaluated in this preliminary study covered a wide range of applications. As such, they would also vary considerably with respect to the various evaluation criteria enumerated at the beginning of this Chapter.

A comparative summary of the relative impact of each of the options under each of the evaluation factors is presented in Figure 10. Given the preliminary nature of this study, a simplified relative rating scale is appropriate, with impacts generally ranging from unfavorable to favorable.

Figure 10 provides a convenient, simplified assessment of relative impacts; many of the items are discussed in somewhat more detail in the pages that follow. For the spot location option, separate categories are shown pertaining to the "individual bridges" versus the "Minnesota River screenline" strategies, which differ, to some extent, in intent and effectiveness. Similarly, the capital HOV/LRT corridor options are also shown with two components, each of which is significantly different. In one case, tolls would be assessed to non-HOV traffic using the mixed-flow lanes while in the other case, tolls would be assessed to non-HOV traffic to gain access to HOV lanes. The remaining three concepts shown in Figure 10 include single corridor options, the full freeway pricing scheme and the MUSA area pricing concept.

The full freeway pricing concept would be expected to have the most significant potential for congestion relief and the highest revenue potential. However, given its broad application, it would probably have the most unfavorable impact on low income users and local traffic diversions. The most direct incentive for increased transit utilization and/or ridesharing would likely come by implementing tolls in the mixed-flow lanes in the immediate HOV/LRT corridors. The MUSA area pricing scheme would appear to have the least potential in terms of congestion relief and mode shift incentives, and would have the primary advantage of fostering development in patterns which are consistent with regional development goals. However, the same objective could also be achieved, to some extent, through specific pricing strategies under other options, such as the full freeway pricing system.

EVALUATION CRITERIA	SPOT LOCATIONS		HOV / LRT		SINGLE CORRIDOR OPTIONS	FULL FREEWAY PRICING	MUSA AREA PRICING
	Ind. Bridges	Screen-line	Toll Non-HOV	HOV Buy-In			
CONGESTION RELIEF							
• SOV Reduction	○	◐	●	○	◐	●	○
• Congestion Reduction	◐	◐	◐	◐	◐	●	○
• Travel Time Reduction	○	◐	●	◐	◐	◐	○
MODE SHIFT POTENTIAL							
• Increase Transit	○	◐	●	○	◐	◐	○
• Increase Ridesharing	◐	◐	●	○	◐	●	◐
REVENUE/COST CONSIDERATIONS							
• Revenue Potential	◐	◐	◐	○	◐	●	◐
• Revenue/Cost Ratio	◐	●	◐	◐	◐	●	○
OPERATIONAL EFFECTIVENESS							
• Ease of Use	◐	◐	◐	○	◐	◐	○
• Ease of Enforcement	●	●	◐	○	●	◐	○
PUBLIC/POLITICAL ACCEPTABILITY							
• Equity/Availability of Options	●	◐	◐	●	◐	●	○
• Low Income Impacts	◐	◐	◐	◐	◐	○	◐
• Business Impacts	◐	◐	◐	◐	◐	◐	◐
• Local Traffic Diversions	◐	◐	◐	●	○	○	◐
AIR QUALITY IMPACTS							
• VMT Reductions	○	◐	◐	○	◐	●	○
• Improve Average Speeds	○	◐	◐	◐	◐	◐	○
REGIONAL DEVELOPMENT GOALS	○	◐	◐	○	◐	◐	●

○ Unfavorable Impacts
◐ Moderate/Neutral Impacts
● Favorable Impacts

OVERVIEW OF RELATIVE IMPACTS

Other Considerations

Beyond the traffic, revenue and cost implications discussed above, there are a number of factors that should be taken into consideration when evaluating the viability of implementing congestion/road pricing. The remaining sections of this chapter deal with these considerations, both in general terms and, where appropriate, with respect to each of the alternative options studied.

Potential Uses of Revenue - As described above, congestion/road pricing programs are likely to generate a substantial revenue stream. The uses of these revenues will influence public support for the program as well as the effectiveness of the program itself. The potential uses of revenues should be based upon principles that reinforce the overall objectives of congestion/road pricing.

- **Implementation Costs** - Revenues should first be applied to the annualized operating and capital costs associated with the collection of tolls and fees. This would include the costs of enforcement, public outreach, and administration. For most of the scenarios analyzed, this cost represents from 10 to 25 percent of the revenue potential;

- **Provision of Travel Alternatives** - Revenues should be applied to provide reasonable transportation alternatives to peak period SOV travel. Transit services and facilities, HOV lanes, and improving alternate routes could all be supported by program revenues. Providing attractive options, particularly if they offer faster travel and/or less expense travel, will help foster support for congestion/road pricing. These alternatives should be in place at the start of a project;

- **Mitigation of Negative Impacts** - Revenues could be used as direct subsidies to reduce cost impacts to low-income travelers. Such compensation would need to be designed so as to maintain the incentive for changing travel behavior. Compensation could be in the form of travel allowances. This use of revenues would address equity concerns of those who might be penalized by the program;

- **Implementation of the Regional Transportation Plan** - Revenues could be directed towards furthering improvements identified in the regional transportation plan. This program would include appropriate transit and highway improvements in keeping with the dampened travel demand resulting from congestion/road pricing;

- **Reduced Taxes** - Revenues could be returned to travelers in the form of reduced taxes. Revenues could substitute for a portion of property, gasoline and excise taxes currently imposed. If there is opposition to congestion/road pricing because it is viewed as a new tax and revenue source for government, one approach could be to structure a "revenue neutral" program by reducing existing taxes; and

- **Other Uses** - Revenues could be applied to any number of non-transportation public uses. However, this would weaken the "pay-as-you-go" approach to transportation financing and would establish congestion pricing as another tax.

Revenue use decisions must reflect a variety of public policy considerations related to transportation needs, equity concerns, and jurisdictional priorities.

Public/Political Acceptability - Congestion pricing options will be perceived as more or less acceptable depending on the nature and extent of the pricing scheme. As the examples of congestion pricing programs and plans suggest, several important issues can "make or break" congestion pricing proposals. Issues include perceptions of fairness, proposed use of funds, possible impacts on businesses and low income groups, and privacy concerns. Acceptability will be enhanced by consulting with affected parties at the outset of planning, as well as developing liaison with likely supporters. A revenue neutral program may enhance acceptability as compared with a program where pricing is perceived simply as a way to raise revenues. A preliminary public information plan is provided in Chapter 6.

Especially important to political acceptability of congestion pricing proposals are the number of potential winner and loser groups, and their likely positions on congestion pricing proposals. The number of winners and losers depends on how motorists, transit, rideshare patrons and taxpayers perceive changes in travel time and tax burdens. Winners, for example, may be a large group of taxpayers if tolls reduce their tax burden. However, if taxpayers receive a small benefit they will have little stake in promoting congestion pricing. Motorists valuing reduced travel time more than the toll are winners, but they may, or may not, actively support congestion pricing depending on their confidence in planners and potential managers of the congestion pricing program. Motorists perceiving the need to shift to alternative modes or other road facilities may resist congestion pricing proposals, even if improved facilities or modes are promised. Again, all depends on how credible and extensive such proposals are.

Because active support of congestion pricing plans is vital to political acceptability and agency approval of proposals, it is important to identify and involve possible supporters early in the planning process. Possible supporters include those who benefit from reduced congestion:

- Neighborhoods where traffic might be reduced;
- Commercial enterprises highly dependent on goods delivery and traveling sales force;
- Environmental interests concerned with air quality;
- Transit operators receiving support for expanded capital stock and experiencing better speeds under less congestion; and
- Automobile organizations interested in expanded road facilities, provided congestion pricing is part of a broader plan to add highway capacity at critical locations.

Consistency with Regional Goals - This section assesses the extent to which congestion/road pricing application options support the regional transportation goals. The level of support for regional goals is evaluated in terms of the following factors:

- Contribution to the region's quality of life in terms of congestion reduction, reduced travel times and improved environment;
- Management of the transportation system to satisfy travel demand;
- Strengthening of transit, paratransit and rideshare;
- Availability of stable funding for transportation facilities and services; and
- Support for economic development and encouragement of growth within the Metropolitan Urban Services Area (MUSA).

This last issue is particularly important, since pricing may well influence future geographic growth patterns. It should be addressed in more detail in future studies.

Contribution to Region's Quality of Life - Among the congestion/road pricing applications examined, the areawide and systemwide options have, by far, the greatest potential for reducing congestion by improving travel time and improving the environment, thus contributing to the region's quality of life. The areawide and systemwide options include implementing congestion/road pricing on freeways/expressways within the MUSA boundary, or within the seven-county area, or on all major roads within the seven-county area, or at a cordon line around the MUSA boundary, or on all HOV and LRT corridors. These are regional applications and, therefore, will result in regional congestion, travel time and environmental benefits. Depending on the application, traffic diversion to arterials and neighborhood streets could have a negative impact on the quality of life for existing users of those routes and residents along those routes. For example, the freeway pricing option would cause the greatest diversion to alternate routes regionally, while the cordon line tolls would limit diversions to the area immediately outside the cordon line.

On the other hand, the pricing strategies would also act to reduce total demand, by providing incentives for increased ridesharing and transit utilization. Consider, for example, the I-35W corridor south of Minneapolis. Projected future demands exceed available capacity even with the addition of carpool lanes and LRT. As such, in the absence of pricing, significant overflow onto the local street system can be anticipated. With a pricing initiative, the overflow would cause greater utilization of the HOV lanes and a higher shift to transit. This would tend to reduce the overall level of demand and free up more available capacity on I-35W, potentially reducing the severity of traffic impacts on alternate routes.

This underscores the need for comprehensive planning of any future road pricing initiative. Not only can future negative traffic impacts be mitigated, to some extent, through use of revenues generated by pricing, but a coordinated program of pricing and increased opportunities for alternative modes such as transit and ridesharing may be able to be used together to achieve a net positive impact.

Spot or facility applications of congestion/road pricing such as on individual bridges or freeways will have very localized beneficial impacts on quality of life. In fact, because of the negative impacts due to spillover of traffic onto parallel routes, the net benefit is likely to be small, if any.

Impacts on Business - The impacts of congestion pricing on business will vary with the structure of the pricing program, the nature of the businesses affected, competition and other factors. Generally speaking, reductions in traffic congestion will create benefits by reducing the travel time (and, therefore, costs) of goods delivery. These savings should offset the direct increases in shipping expenses created by the pricing program. Concerns about impacts on retail businesses relate to shoppers potentially facing high travel costs, particularly if only some retail destinations are affected by the pricing program.

According to several federal studies, truck operators value their time at $25-30 per hour (this will vary for local delivery vs. long-haul, etc.). If on a 20-mile roundtrip, with a relatively low truck toll rate of $0.10 per mile assumed, only about five minutes of overall travel time savings from reduced congestion would need to be realized in order for the trucker to gain from the program.

Additional analysis of impacts on business should seek to differentiate impacts by type of business and by general location. The focus should be on the levels of commercial activity (sales), costs of doing business, and impacts on customers.

Management of Existing Transportation System - One of the primary objectives of any type of road pricing system is to manage the transportation system to satisfy travel demand while making the most effective use of limited resources. All of the options evaluated would provide some measure of demand management. The spot application of pricing would act to redistribute traffic between facilities and, to a lesser extent, encourage ridesharing, or demand reduction. It could also provide incentive to changes in the time of day trips are made. The concept of pricing mixed-flow lanes on segments adjacent to HOV lanes would provide a more direct incentive to ridesharing and thereby achieve a more balanced utilization of total available capacity while acting to reduce vehicular miles of travel.

In general, the broader the application of pricing in the region, the greater the ability to manage demand and thus achieve regional goals and policies. The placement of congestion/road pricing on the entire limited-access freeway network would have the greatest potential to achieve demand management objectives by both reducing and redistributing demand more efficiently over the existing network. The use of electronic pricing would make it possible to adjust rates by time of day and roadway section to achieve the optimum balance and overall management of the system. If a portion of revenues generated from the pricing system were used to create travel alternatives, such as enhanced transit or ridesharing opportunities and/or improvements to alternate routes, the overall system management capabilities would be further increased.

Strengthening of Transit - Congestion/road pricing would provide a direct, highly visible, monetary incentive for increased use of transit and/or ridesharing. The extra "price" placed on driving alone would, at a minimum, reduce the perceived cost of transit fares, thereby increasing the transit share especially for work trips. Congestion/road pricing applications would also provide opportunities for generating revenue. Part of these revenues can be used to strengthen the transit system (regular route, paratransit and rideshare). The principle is that the better the transit system is, the greater the success of congestion/road pricing. An improved transit system will provide increased choices for SOV users that are unwilling to pay the road pricing fee, which in turn will make the transit system more cost-effective.

On the other hand, effective congestion pricing would tend to reduce overall congestion and make auto trips faster and more dependable, making them somewhat more competitive to transit. This would be affected by the direct monetary cost associated with the choice to continue to drive - particularly driving alone.

Availability of Stable Funding for Transportation - Because of the dollars involved, areawide or systemwide congestion/road pricing provides a "pay-as-you-go" revenue generating method that is relatively stable. Unlike gas tax revenues, which have experienced a decline due to improved vehicle fuel efficiency, revenues from congestion/road pricing would increase because of the historical growth in vehicle-miles of travel.

Support Economic Development - The effect of congestion/road pricing on economic development is not well understood. However, the following observations can be made and should be tested in subsequent phases of the study of congestion/road pricing:

- It would appear that central business districts (CBDs) would benefit from congestion/road pricing because they have the best roadway and transit access and, thus, the most choices. This is true of commuter trips. However, shoppers might be unwilling to pay the fee to shop in the CBD, especially during off-peak periods. (This may be a reason to not charge a fee during off-peak periods.)

- While the great majority of the region's population and employment is within the MUSA boundary, residential and other development outside the MUSA continues. One of the main reasons for this occurrence is that there are no incentives to live closer in. The transportation system currently provides relatively congestion-free travel to jobs in the outer rings of the region. Distance-based congestion/road pricing would make it less attractive to live in the rural or developing areas and work, say, in the CBDs.

- Residents of counties adjacent to the seven-county area could be discouraged from working or shopping in the region, particularly if areawide or systemwide congestion/road pricing applications are implemented. This is particularly true if revenues generated are used only for improving transportation facilities and services within the seven-county area.

- An unknown at this time is whether, under the areawide or systemwide options, new businesses will make a different location decision, or whether existing businesses would relocate, to avoid the tolls.

The conclusion is that specific geographic areas within the seven-county region could experience an economic gain at the expense of other geographic areas but, overall, the economic impact is likely to be neutral. The exception is the case where a business would locate or relocate outside the seven-county area. Imposition of an entry fee at the MUSA boundary might encourage some residents or businesses to move into the MUSA area. Others, however, might decide to move into the rural areas and outer rings to avoid the tolls. How these decisions are made will depend, to a large extent, on how adverse impacts to commuters, residents and businesses, and geographic impacts, are mitigated. Mitigation measures could include commuter rebates, peak-period-only charges, improved services to affected business centers, various tax rebates, etc.

Impacts on Low Income Travelers

The impact of congestion pricing on low-income travelers depends upon the adopted price level, the time savings achieved and employment locations, among other factors.

The lower the value that is placed on one's time, the less there is to gain, in an economic sense, from congestion pricing. According to federal studies, travelers making work trips value their time at $11.00 per hour; on average, those making non-work trips value their time at $8.00 per hour. If, for a typical 20-mile roundtrip, a relatively low toll rate of $0.05 per mile is imposed and five minutes of travel time is saved, then only those workers whose annual incomes exceed $25,000 would stand to gain based on their value of time. For non-workers, their income would need to be 25-50 percent higher.

The impacts on low-income travelers will depend on the availability of travel alternatives and residential and employment characteristics. Low income residents are more likely to live in areas where transit services are available, and transit service would tend to improve under congestion pricing.) Some would be induced to change from auto travel to bus. However, many low income travellers must use a car because transit is not available or for child pick-up, etc.; if employed, they may have little flexibility to alter work hours and thus would face peak period charges. Those not employed would have greater flexibility in altering travel times to avoid peak period surcharges. These changes could be significant to the individual traveler especially if travel distances are long.

A carefully structured congestion pricing program that maximizes alternatives and provides some form of subsidy would help mitigate these potential negative effects on low income travelers. A portion of the revenue collected from the pricing program could also be used to reduce the negative impact on the poor.

Land Development Considerations

The implementation of congestion/road pricing might be expected to have some limited impacts on future land development patterns, depending on the scenario and the scope of application. For example, an area entry pricing scheme focused around the immediate central business districts, such as Singapore, might act to encourage utilization of businesses outside the protected area and therefore might influence future commercial development patterns. That particular scenario was not, however, among those selected by the Steering Committee for further review. The MUSA line entry toll program was explicitly designed as an incentive to continue future development within the MUSA area. This is consistent with regional transportation planning goals, which state that future highway and transit services will be focused in the urban development area. This would be a direct positive impact of implementing pricing on regional development patterns.

As noted in the previous section, it is difficult to identify some of the more subtle economic development impacts. For example, if all freeways in the region were subjected to tolls, it would not be expected to result in a significant change in future development patterns. However, if only one or a few of the freeways were tolled, this could affect development choice locations for both residential and commercial development. As noted previously, potential impacts on economic development patterns should be the subject of more detailed analysis in refined studies which could happen in future phases.

Air Quality Considerations

Congestion pricing may reduce vehicle emissions by reducing vehicle trips. Trip curtailment and shift from solo driving to HOV modes would result in reduced vehicle trips and vehicle-miles traveled (VMT) and produce reductions in emissions. Changes in travel routes and in trip times is likely to have more complex differential impacts on emissions and air quality. These changes may not directly reduce VMT, but by shifting VMT away from hot spots and hot periods, they could produce improvements at the worst locations and times. In making the estimate of VMT reduction, evaluation analysts should be careful to assess net reductions in VMT. This can be done by examining changes in trip volumes and lengths not just on the priced facility, but on possible diversion routes, and comparing results to changes in the same variables on control facilities not priced.

Studies on I-35W have shown that traffic diversions to local streets are likely to occur even with incentives for modal shifts on I-35W. The factors which most adversely influence air quality on local streets are: (1) high traffic volume, (2) low traffic speed, (3) long delays (particularly idling at intersections), and (4) intersection controls, (which affect speeds and delays). Traffic that diverts to local streets as a result of congestion pricing may have an adverse impact at congested intersections.

Major air quality benefits may accrue from reduction in congestion levels by themselves. While existing models are not very good at estimating the emission impacts of reduced congestion and resulting reduced speed change cycles, there is increasing consensus among experts that these benefits may be dramatic.

Evaluations in the second phase can assess the air quality benefits of congestion pricing by using data coming from the transportation impact assessment and working in collaboration with the local air quality district and/or regional EPA and PCA offices. With information about reduction in VMT and vehicle trips and, if possible, changes in average speeds and speed change cycles, air quality planners would be able to calculate emissions effects based on a profile of that particular vehicle fleet for the region.

Equity Considerations

An important consideration in assessing congestion pricing options in the region is equity: how costs and benefits of the options affect particular groups. While detailed assessments of this kind are outside the scope of this first phase study, they should receive considerable attention in the second phase. Such consideration will help chart the most politically feasible course, help determine those made worse off and where compensation should be focused. Some categories to consider include income group, peak versus off peak travelers, and in- versus out-of-zone workers, businesses and residents.

Benefits

In general, one would expect positive benefits due to reduced congestion to accrue to:

- *Existing users of HOV modes and HOV service providers:* A reduction in congestion from the pricing program could significantly increase HOV mode speeds, productivity and reliability, in those corridors where dedicated HOV lanes do not exist. Existing users would enjoy significantly improved service even before additional resources are put into these modes. The providers of HOV service (e.g., bus operating agency) could benefit from significant increases in vehicle productivity as speeds increase.

- *Road users who shift from SOV mode to HOV due to pricing incentives:* Those who voluntarily are attracted to HOV modes due to enhanced service levels (brought on by improved productivity and reliability or by pricing incentives) would realize positive benefits from the opportunity to use a more desirable mode.

- *Road users who continue to drive and value their time highly (including most commercial vehicles):* The value of time savings produced by lower congestion and increased speeds would outweigh the increased congestion toll payments for these users.

- *Businesses who would reap the benefits of more efficient delivery systems:* Businesses where trucking and delivery system costs are a significant proportion of total costs of doing business would realize large savings in delivery costs.

■ *Population segments who will enjoy cleaner air:* Persons living/working near high concentrations of pollutants produced by vehicle emissions would enjoy cleaner air.

■ *Major recipients of the revenues generated by the pricing program:* Congestion pricing promises to generate large new revenues, far in excess of program costs. For instance, if revenues are used to expand HOV modes, the original and new users of these modes would enjoy the benefits. If revenues are used for in-lieu reductions in existing taxes such as registration fees, the affected motorists would gain. If revenues are used to compensate particular road users or businesses, they would benefit. Depending on the compensations, such distributions could partly or fully mitigate negative impacts of pricing on these groups.

Disbenefits

■ *Those who do not value their time highly and/or cannot afford the increased charges:* Those who are forced to pay more than their time savings, or involuntarily shift to other modes of travel, routes or time of travel, would lose benefits. Also those who must decide to forgo the trip altogether. Low income travellers are subject to the above effects.

■ *Certain businesses in the region who might lose competitive posture compared to those in outlying uncongested areas:* While many businesses may benefit from improved speeds for goods delivery and employee commutes, some businesses within the prized zone may be disadvantaged vis-a-vis competition from outside the priced zone. The level of impact would depend largely on the size and location of the priced zone or area. Again, how complementary programs and actions are structured can change this picture.

■ *Users of unpriced facilities in the region:* Travelers on certain facilities not priced may experience increased costs of congestion if much traffic is diverted from priced facilities.

■ *Neighborhoods:* Certain neighborhoods may be affected by spillover traffic. This is particularly true of neighborhoods where good alternative parallel arterials or transit facilities are unavailable.

In particular applications of congestion pricing, the magnitude and incidence of adverse impacts would depend upon the design and scope of the congestion pricing program. Each of the three major congestion pricing applications - areawide pricing, single facility pricing, and pricing of regional expressway and arterial network - would have very different distributional implications and call for different complementary actions:

- *Areawide Pricing:* In the downtown of a large urban area, congestion pricing might lead to limited spillover confined to a few peripheral streets. Signal changes, restriping and preferential parking for residents are logical complementary actions to consider.

- *Single-Facility Pricing:* Congestion pricing of an expressway segment or a bridge crossing could have more widespread distributional implications. The prices would affect much more diverse origin-destination patterns than an area program. In this case, the critical task would be to identify the adversely affected parties and design appropriate complementary actions.

- *Regional Network Pricing:* Comprehensive pricing of a regional (or subregional) arterial and expressway system, without attention to complementary action, may cause spillover traffic.

In short, the broader the application of congestion/road pricing, the less of an issue equity will become. By contrast, the more narrow the application, such as an individual facility or spot location, the more likely equity will become a focal point of opposition, with opponents citing potential discriminatory pricing practices.

It is very important to identify the benefits generated by congestion/road pricing "in return for increased prices." From the individual user's standpoint, the primary benefit is time savings. For users with a high value of time, the benefits are more obvious. Other users with relatively low values of time, however, will be losers at first glance, because they could fail to see the benefits of reduced air pollution, economic impacts from massive reductions in trips, etc. For these users, some form of compensation could be developed to make them as well, or better off, than before the pricing program. It should be recognized that congestion/road pricing, in aggregate, would generate net positive benefits.

Chapter 6
THE NEXT STEPS

From the results of this preliminary study, it is clear that the implementation of most of the congestion/road pricing alternatives studied would be feasible, from a traffic, revenue, technology and financial point of view. Almost any of the options evaluated in this preliminary study would achieve some benefits in terms of demand modification and, with few exceptions, would be at least self liquidating in terms of revenues and cost. In most cases, the options were found to produce significant amounts of additional revenue, above the cost of implementation and operation, which could be used to mitigate negative impacts, finance future needed transportation improvements and/or establish other corollary actions to further modify demand (such as transit and ride sharing subsidies).

This was, however, a very broad-brush preliminary study. Considerably more detailed work will be needed before an actual pricing strategy should be implemented. This chapter identifies a possible phasing program of future studies. In addition, it provides a recommended program of public participation and information. This may well be one of the single most important elements in ultimately implementing any type of congestion/road pricing program; building public consensus for the need and acceptability of the program.

Future Studies

This study of congestion/road pricing was intended to examine road pricing application options, to analyze their feasibility in the Twin Cities area, and to prepare a public participation plan aimed at securing future public acceptance for congestion/road pricing. A variety of application options was evaluated and the conclusion was reached that congestion/road pricing is feasible in the Twin Cities area. The following paragraphs outline the steps needed to move toward implementation of a specific congestion/road pricing project.

1. Conduct a Scoping Study

The scoping study would expand on the present congestion/road pricing concept study. Its purpose would be to select a limited number of specific options and/or projects for detailed impact analysis. The public participation process would also be initiated in this phase and would include market research, roundtable and focus group discussions with stakeholders, public information/education, etc.

2. Conduct Detailed Alternatives Analysis and Impact Analysis

In this phase the options and/or projects identified in Phase 1 would be evaluated in detail. A full accounting of impacts and mitigating actions would be made and a project would be selected. Public participation would continue in this phase with the intent of reaching informed consent on the application option and project selected.

3. Conduct Preliminary Design and Develop Implementation Plan

In this phase, the congestion/road pricing project would be fully designed in terms of the toll collection method and technology, detailed cost and financial plan, revenue distribution strategy, prioritization plan, implementation method--including build-operate-transfer and build-transfer-operate--and schedule. Implementation of the public involvement plan with affected parties would occur in this phase, and the responsible agency would seek legislative approval.

Public Involvement Plan

Public understanding acceptability is a key component of implementing new policies such as congestion/road pricing. Congestion/road pricing proposals typically generate concerns about equity, business competitiveness, impacts on the poor, "double taxation," and use of revenues. If a decision is made to implement a regional congestion/road pricing program in the Twin Cities, it will be very important to structure the program so that it is both socially and politically acceptable. This will require a long-range, comprehensive plan to understand the public perception of need and benefit, to involve a wide array of special interest groups or "stakeholders," and to educate the public about the costs and benefits of the proposed program. To accomplish this objective, it is imperative that the plan provide for public involvement in the development and evaluation of program options.

The Public Involvement Plan is a step-by-step process for understanding public needs and perceptions, providing information and education, bringing a wide array of actors into the planning process, developing pricing programs with their inputs, and nurturing support for the congestion/road pricing concepts.

The Public Involvement Plan includes the following four key steps, as shown in Figure 11.

1. **Market Research**

    - To better understand the transportation "customer" (transportation system users), their understanding of transportation vocabulary, and their perception of need.

    - To test hypotheses about individual perceptions of costs, benefits, congestion, delay, transportation funding, etc.

    - To identify key "stakeholders" or special interest groups that may become strong advocates or opponents and determine their principal concerns and perceptions about congestion/road pricing.

    - To identify a small group of key legislators that may be involved as advocates or opponents of congestion/road pricing and determine their principal concerns and perceptions about congestion/road pricing.

2. **Product Development**

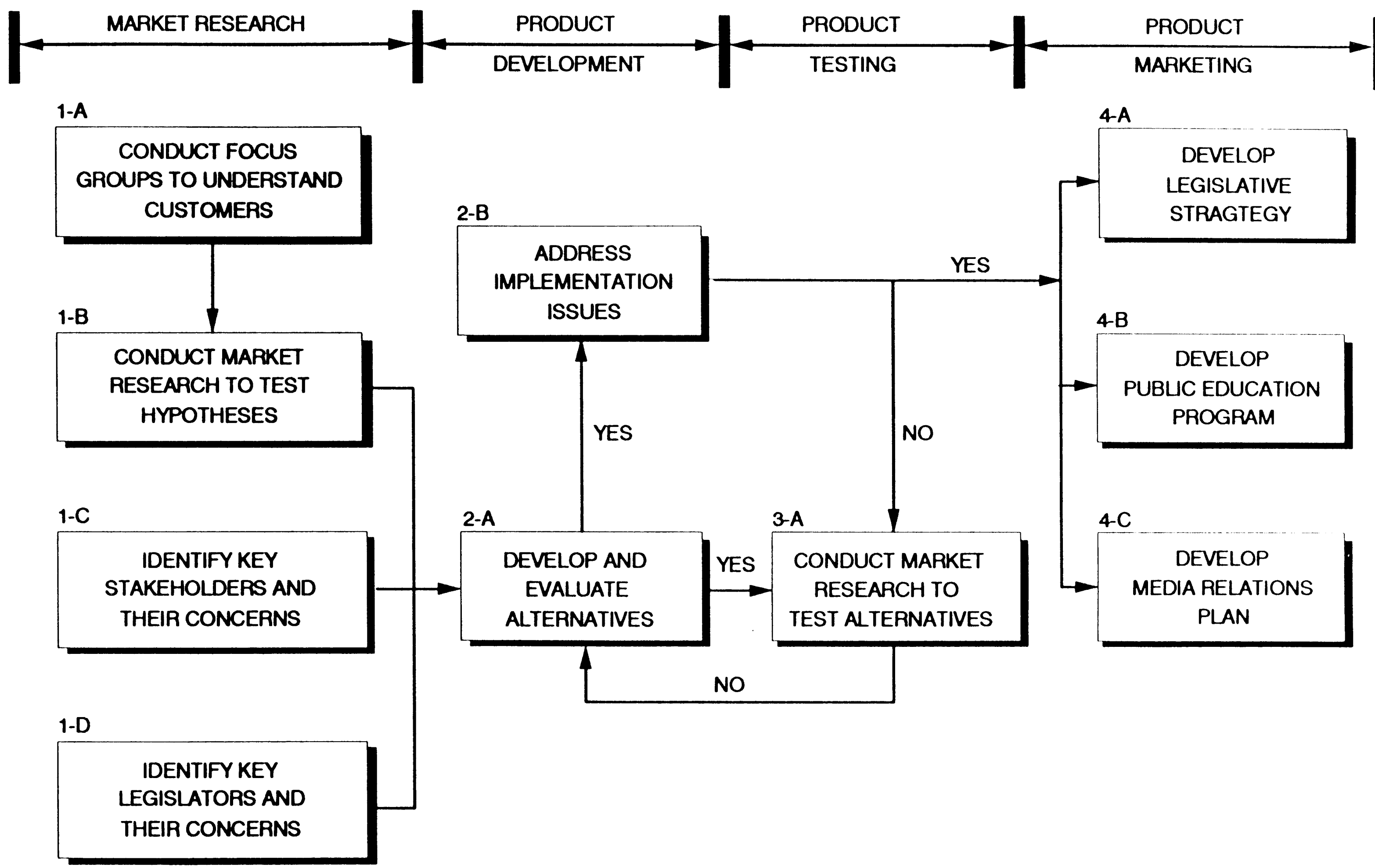
    - Involve key stakeholders and legislators in the development of alternatives.

    - Evaluate congestion/road pricing strategies.

    - Identify implementation issues (legal, legislatures, political).

3. **Product Testing**

    - Conduct market research to test public reaction to proposed strategies.



PUBLIC INVOLVEMENT PLAN FOR CONGESTION / ROAD PRICING PROJECTS

WILBUR SMITH ASSOCIATES

FIGURE 11

4. **Product Marketing**

- Develop a legislative strategy for gaining legislative support for necessary legislation.

- Develop and implement a media relations plan.

- Develop, implement and conduct a lengthy public education program regarding proposed strategies.

Throughout this process, the option should always remain to delay implementation of a congestion/road pricing project. For example, there will not be broad support for a congestion "solution" such as congestion/road pricing if there is not broad recognition of a congestion "problem." Under that scenario, the implementation of congestion/road pricing strategies should be delayed until there is general recognition that these strategies are needed to address real problems.

1. **Market Research**

A. Market Research to Understand "Customers" - The first step in the Public Involvement Plan should be to develop a much better understanding of the transportation user or "customer" and his/her perception of need. It is suggested that several focus group discussions be held in this step to determine the transportation vocabulary used by most lay people and their level of understanding of various methods and technologies of congestion/road pricing. These focus groups could also be used to gain a general understanding of the perception of congestion as a problem and the thresholds of delay which would tend to trigger a willingness to pay for congestion relief. Every person is a transportation customer in some way; however, transportation customers typically fall into the following groups:

- Auto Users - This group includes users who would directly benefit from reductions in congestion; those who must change their travel behavior because they are unwilling to pay users charges; and travelers who may be at an advantage or disadvantage due to variable work hours or vehicle occupancy pricing. Commuter and non-work travelers are distinct sub-groups.

- Fleet Operators - Local and long-distance trucking firms can be expected to have strongly held positions on congestion pricing. These positions need to be understood. Previous market research indicates that there are differences in concern by type of firm (local versus intercity).

- Rideshare/Transit Users - These groups are likely to receive favorable treatment with respect to user charges. These travelers would clearly benefit if revenues were used to improve facilities and services. They would also benefit from reductions in traffic congestion (improved travel speeds, more reliable trips).

- Businesses - Some businesses may feel at a competitive disadvantage due to charges imposed on their customers and delivery vehicles. Businesses would also benefit from congestion reduction by speeding deliveries and improving access for customers.

- Low-Income Travelers - Those who cannot afford user charges could lose access to employment opportunities, medical facilities, and other essential destinations. If revenues are used to support alternative modes (e.g., transit), this access could be preserved for low-income auto users and improved for others.

B. Conduct Market Research to Test Hypotheses About Congestion/Road Pricing - Based on a review of previous studies, it is possible to anticipate the general reaction to alternative congestion/road pricing scenarios. Factors found to influence acceptance include the geographic scope of the project, the level of user charges, ease of payment, potential travel delays, perceived equity with respect to benefits and disbenefits, and the availability of travel options not subject to congestion/road pricing. The likelihood of public acceptance should be one of the evaluation criteria for screening the universe of scenarios. Scenarios that are likely to create severe opposition should be modified, accompanied by mitigating actions, and/or excluded from further consideration.

In this step, a survey of a statistical sample of people would be conducted. While a telephone survey is possible, it may be necessary to conduct personal interviews because the subject is rather complex. The sample population would be asked to place a value on the above mentioned factors which influence acceptance and on various methods of congestion/road pricing.

Further direct surveys or involvement of the general public is not recommended until more detailed study of specific proposals is undertaken and the objectives for a congestion pricing program are more clearly defined (see Step 4).

C. Identify Key "Stakeholders" and Their Concerns - Stakeholders are special interest groups that may become strong advocates or opponents of congestion/road pricing. In this step, key stakeholders would be identified and contacted to solicit their concerns and ideas (a preliminary list of stakeholders is shown in Appendix B). This task could be accomplished with a selected number of one-on-one meetings or with focus groups. Stakeholders may also be customers, either individually or collectively, and customers may also be stakeholders. Generally, the potential stakeholders in a congestion pricing program include:

- Business Associations - Large employers and, in particular, retail businesses may view congestion/road pricing as an adverse impact to their businesses, employees and/or customers.

- Trucking Associations - Trucking associations are expected to oppose congestion/road pricing because of the increased cost to move products to market. However, if certain scenarios were shown to reduce delay, provide a better opportunity for just-in-time shipping, or be a fair way of generating revenues for transportation, they might be supported by the trucking associations.

- Individual Communities - Depending upon the program configuration, particular communities (for example, downtown businesses or suburban commuters) may feel unduly burdened if they are required to pay user charges.

- Environmental Groups - The potential benefits of congestion/road pricing (that is, congestion reduction and increased transit and carpool use) may generate the support of environmental groups. However, specific scenarios could contribute to concentrating, slowing down or diverting traffic to local streets. These impacts could result in adverse environmental impacts and, therefore, opposition from environmental groups.

- Neighborhood Groups - Neighborhoods adjacent to facilities or within areas included in the congestion pricing program may be affected by traffic diversions or spillover parking.

- Local Officials - City officials, Metropolitan County Commissioners and other elected and appointed local and regional officials will need to be involved in these discussions.

- Other Groups - A variety of other stakeholders exist including taxpayers, private "for hire" vehicles, people who use vehicles for work (sales, service, etc.), public agencies, etc., who would be directly or indirectly affected.

D. Identify Key Legislators and Their Concerns - Legislators who may be important participants in decisions relative to congestion/road pricing should be identified and contacted to explain the goals of the program, to share the findings of the market research, and to describe alternate scenarios. These contacts should be made in very informal one-on-one informational meetings and should focus on gaining an understanding of legislative concerns about the congestion pricing concept and discussing the likely need for future legislation and the proposed process for gaining customer and stakeholder support. Discussions regarding costs and benefits and possible integration with other transportation proposals would also be important for these information meetings.

2. Product Development

A. Involve Key Stakeholders and Legislators in Development and Evaluation of Alternatives - In this step, representatives of key stakeholders and key legislators should be involved in the development and evaluation of alternative congestion/road pricing strategies. Potential stakeholder support or opposition should be clarified as part of a detailed study of congestion pricing scenarios. It is recommended that this task be accomplished using a committee or task force which would provide advice to the technical staff on the project. It will be important to include both potential advocates and potential opponents in this discussion process.

B. Address Implementation Issues - Any implementation issues such as legislation, administrative needs, funding, use of revenues, equipment, etc., should also be addressed at this time. These issues should be resolved with both legislative and stakeholder input.

The sponsors of congestion/road pricing proposals are likely to be implementing governmental entities, and thus, may not be effective public champions of the program. A broad-based public/private coalition could prove far more effective, complemented by individual spokespeople. Developing this team will require a designated individual to lead an extensive liaison with potential supporters.

This step also provides the opportunity to develop a volunteer support group of civic leaders for speaking to neighborhood and civic groups. These individuals, along with agency staff, can act as "champions" and can become highly informed participants in the public discussion about congestion pricing.

3. Product Testing

A. Conduct Market Research to Test Public Reaction to Proposed Products -

Market research (stated preference surveys, focus groups) and public outreach programs (individual and group meetings) should be conducted at this point to gauge reaction to proposed actions. This research can help establish the acceptable limits of the congestion/road pricing program in terms of scope, levels of user charges, use of revenues, etc. The research should identify key concerns that must be addressed through a marketing plan.

The market research should focus on reactions and ideas related to specific courses of actions and outcomes. This would involve describing ranges of options in terms of type of pricing, method of payment, amount of charges, and use of revenues. This approach recognizes that behavior is based on a combination of incentives and disincentives.

4. **Product Marketing**

A. Develop a Legislative Strategy - Armed with technical and financial information about the congestion/road pricing proposals and extensive information about customer and stakeholder concerns, staff and project spokespeople would meet with key legislators to discuss legislative needs and to develop a strategy for obtaining any necessary legislation.

B. Develop and Conduct a Lengthy Public Education Program - The previous market research activities should have identified the key concerns that people in the Twin Cities have regarding congestion/road pricing. In this step, a long range public education program would be implemented to address these concerns and to educate the public about proposed congestion pricing programs, their costs and their potential benefits. Methods should include a mix of written materials such as newsletters, public information meetings, and informal meetings with interested parties. The following is a recommended approach to a long-range public education program related to congestion/road pricing:

- Document the Need - It is unlikely that congestion/road pricing will be acceptable if people do not believe congestion is a significant problem or if congestion does not change much with pricing.

Describing current and future need in terms of existing and projected congestion in terms of travel times, delay and cost will be a critical factor throughout the Public Involvement Program. This might be accomplished through the preparation of white papers addressing key public concerns, through the publication of articles, through public information meetings, etc.

- Explain the Technology - Previous studies show a predominant concern is related to delays associated with paying user charges. The superiority of AVI/ETTM must be presented and confidence established in the reliability and accuracy of this technology. The description of proposed pricing scenarios should answer the questions: How do I pay? How long will I have to wait? What is monitored? What are the enforcement methods?

- Demonstrate the Benefits - The ways in which congestion can be alleviated through pricing, and the resulting benefits (e.g., more reliable travel times for businesses, improved air quality, more support for transit), should be clearly documented and should become part of the public education program. If revenue generation is the goal, projects to be funded should be specified.

- Address Public Concerns - The public education effort should not pretend that congestion pricing is a "win-win" approach. It should acknowledge legitimate concerns and problems, and address them. Where possible, mitigating actions should be supported for potential "losers." For example, subsidies for low-income travelers (perhaps in the form of electronic vouchers) may be warranted.

- Present a Range of Pricing Alternatives - A flexible approach to presenting congestion pricing options would allow for a mixing and matching of elements in response to public concerns. This "sifting and winnowing" would allow for trial balloons and help gain public acceptability.

- Develop Choices - Users should be given the choice of paying the pricing fee or put up with congestion (delay), or seek out alternate routes, or using transit, ridesharing.

- Develop Collateral Actions - Congestion pricing should be part of an overall program of transportation improvements. This may include transit and highway improvements and other Travel Demand Management strategies. Such a package is more likely to have "something for everyone" and to be more socially and politically acceptable.

- Identify Intended Use of Revenues - Congestion pricing has the potential for generating substantial additional transportation revenues. Potential uses of the revenues (for example, transit improvements, roadway improvements, reduction in vehicle fees, reduction in taxes) should be carefully explored and explained.

- Address Privacy Issues - Electronic forms of payment are likely to generate concerns about monitoring, confidentiality and right to privacy. The public should be informed about the proposed payment process, the limits of monitoring and the security of the information.

- Be Responsive - Be prepared to modify program dimensions, as needed, to respond to public concerns.

C. Develop a Media Relations Plan - Finally, hopefully with support from customers, stakeholders and legislators, a media relations campaign may need to be undertaken. Techniques for interacting effectively with median might include feature articles, press conferences and press releases, videos, technology demonstrations, videos, meetings with editors, etc.

Appendix A

PROJECT MANAGEMENT TEAM

APPENDIX A

PROJECT MANAGEMENT TEAM

REPRESENTATIVE	ORGANIZATION
Dennis Foderberg	Center for Transportation Studies - U of M
Frank Lilja	Mn/DOT
Carl Ohrn	Metropolitan Council
Dave Engstrom	Metropolitan Council
Adeel Lari	Mn/DOT

STEERING COMMITTEE

REPRESENTATIVE	ORGANIZATION
Gene Ofstead	Mn/DOT
Merritt Linzie	Mn/DOT
Lee Munnich	University of Minnesota
Gary DeCramer	University of Minnesota
Tom Johnson	Hennepin County
Lyle Berg	City of Bloomington
Dick Stehr	Mn/DOT
Fred Tanzer	Mn/DOT
Clarence Shallbetter	Regional Transit Board
Nacho Diaz	Metropolitan Council
Allen Lovejoy	City of St. Paul
Dwight McComb	FHWA
Jim Wright	Mn/DOT
Amy Vennewitz	Senate Counsel and Research
John Williams	House Research
Herb Mohring	University of Minnesota
Howard Blin	Regional Transit Board
Jim Newland	Private Citizen, Transportation Advisory Board
Steve Bahler	FHWA
Deb Dyson	House Research
Charles Crichton	City of Burnsville, Transportation Advisory Board
Ron Hoffman	Mn/DOT
Chuck Sanft	Mn/DOT
Bob Morgan	City of Minneapolis
Dick Braun	Center for Transportation Studies - U of M

Appendix B

PRELIMINARY LIST OF ORGANIZATIONAL STAKEHOLDERS
Twin Cities Congestion/Road Pricing Study

APPENDIX B

PRELIMINARY LIST OF ORGANIZATIONAL STAKEHOLDERS
Twin Cities Congestion/Road Pricing Study

<u>ACTIVITY CENTERS</u>

Universities and colleges (University of MN, others)
Regional shopping centers ("Dales," MOA)
Major employers (State of Minnesota, 3M, Northwest, GM, Cargill, Pillsbury)
Medical centers
Airports
Convention centers
Major hotels

<u>PUBLIC/PRIVATE ORGANIZATIONS</u>

Neighborhood organizations (central cities, others)
Citizen League
Chambers of commerce
Convention bureaus
Transportation management associations
Automobile associations
Trucking associations
Restaurant/tavern association
Downtown business councils
Labor organizations
Environmental groups
Taxpayer groups

<u>FLEETS</u>

Utility fleets (NSP, Minnegasco, U.S. WEST)
Mail/package delivery (Postal Service, Federal Express, couriers)
Other delivery fleets (warehouse, consumer)
Service fleets (repair, sales)
Local trucking firms (bulk, garbage, movers)
Long distance trucking
School bus operators
For hire operators (taxi firms, private bus operators)
Transit providers (MTC, opt-outs)
Social service providers (Metro Mobility)

APPENDIX B (Cont'd)

PRELIMINARY LIST OF ORGANIZATIONAL STAKEHOLDERS
Twin Cities Congestion/Road Pricing Study

GOVERNMENTAL AGENCIES

Legislature
U.S. (FHWA, FTA)
Mn/DOT
Department of Public Safety
State Patrol (other law enforcement agencies)
State of Minnesota (MPCA, Trade & Economic Development)
Metropolitan Council
Minnesota Rideshare
Metropolitan Transit Commission
Regional Transit Board
Counties (metropolitan and Greater Minnesota)
Central cities (Minneapolis and St. Paul)
Suburban cities
Rural areas (metro and Greater Minnesota)
St. Paul Port Authority
Community development agencies (MCDA, others)